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ABSTRACT

To determine the extent to which differences in occupational and geographic mobility are a result of the learning environment in which a certified electronic technician was trained, and to disclose the differences resulting from the occupation itself, the entire population of over 1,500 certified engineering technicians in New York, New Jersey, and Pennsylvania were surveyed by questionnaire. The results showed great similarity among technicians from different training environments and from different areas of specialization. Differences in geographic and occupational mobility were unrelated to learning environment for all classes of technicians. (BH)

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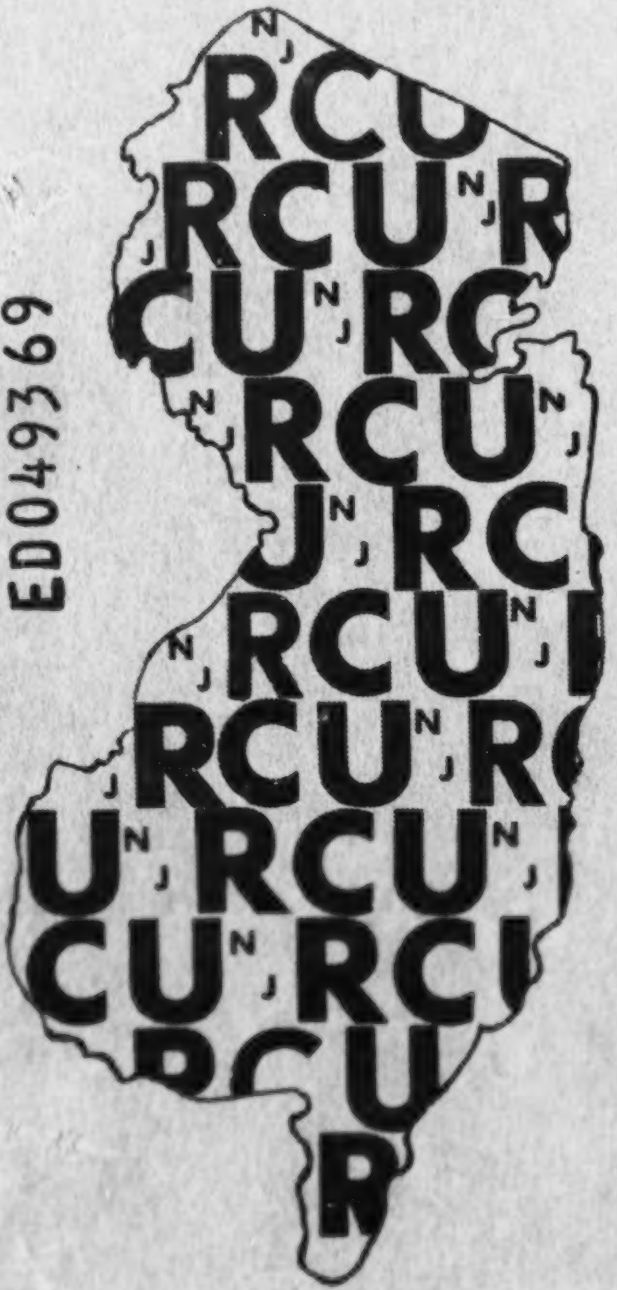

INCIDENCE OF GEOGRAPHIC AND OCCUPATIONAL MOBILITY AMONG CERTIFIED ELECTRONIC TECHNICIANS IN THE MIDDLE ATLANTIC STATES

by

Charles H. Buzzell

OCCUPATIONAL RESEARCH DEVELOPMENT

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PREFACE

The designers of vocational education curricula are under pressure to develop programs which, in light of a dynamic society, are viable instruments for providing students with relevant skills and knowledge. With this as an objective, it is readily apparent that one of the most pressing needs of the curricula developer is data which have significance for assisting in the curricula construction task.

Nowhere in vocational education is the need for analytical data greater than in the area of technical education. However, for many areas of specialization, this need is going unmet. For these reasons the study published here should be of vital concern to the technical educator.

The study's findings and the recommendations which were developed from these findings provide the reader with the essence of the study's dual purpose: (1) to provide the immediate inputs needed by those involved with technical education curricula development; (2) to identify areas for continued research for those who feel that this type of analytical data must of necessity be kept current.

The study represents the continuing effort of the Division of Vocational Education under the direction of Dr. Robert M. Worthington, to support rigorously controlled research into the areas of major concern for the State of New Jersey and the Nation.

Morton Margules, Ph. D.
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ABSTRACT

The principal purpose of this study was to assess the degree to which differential mobility, geographic and occupational, was a function of the type of environment in which the certified electronic technician was trained: high school, post-high school, or on-the-job. In addition, this study also examined the degree to which certified electronic technicians differed from "other" certified technicians relative to geographic and occupational mobility.

The method employed for conducting this study was to evaluate the entire population of certified engineering technicians employed in the Middle Atlantic States Region (New Jersey, New York, and Pennsylvania). The population consisted of 1,563 technicians, of which 880 (56.3 percent) responded.

The instrument used to gather the data was a Questionnaire mailed to the subjects. The subjects were identified, for the study, by the Institute For The Certification of Engineering Technicians. This Institute is sponsored by the National Society of Professional Engineers as the examining body for determining the competencies of those engineering technicians who apply for certification.

The findings of the study were that:

1. Differential geographic mobility among certified electronic technicians was not a function of the learning environment in which they receive their training; i.e., certified electronic technicians trained in post-high school institutions did not have a higher index of geographic mobility than those certified electronic technicians who received their training in either the high school or on-the-job.
2. Differential geographic mobility among certified technicians, other than electronic, was not a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions did not have a higher index of geographic mobility than those certified technicians who have received their training in either the high school or on-the-job.
3. Differential occupational mobility among certified electronic technicians was not a function of the learning environment in which

they receive their training; i.e., certified electronic technicians trained in post-high school institutions did not have a higher index of occupational mobility than those certified electronic technicians who have received their training in either the high school or on-the-job.

4. Differential occupational mobility among certified technicians, other than electronic, was not a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions did not have a higher index of occupational mobility than those certified technicians who have received their training in either the high school or on-the-job.

From the findings of this study 30 conclusions were drawn. These conclusions led to the formulation of the following recommendations:

1. Technical curricula must be developed to meet the training needs of the "stayers," "movers," and the "returners."
2. The striking similarity among technicians from different training environments and

from different areas of specialization suggest the appropriateness of establishing a national system for the retrieval and dissemination of research findings as they relate specifically to the "technical" occupational classification.

3. Valid and reliable measures must be developed and employed for assessing the extent to which a technician's skills, developed during training, are required to change due to his mobility behavior.
4. Technicians must be provided, during their training period, the opportunity to become skillful at "transferring training."
5. Technical curricula must provide learning experiences which will enhance the development of interpersonal relationship skills.
6. Post-high school technical training must be comprehensive enough to provide for:
    A. Incoming high school students with no previous training.
    B. Incoming high school students with extensive high school training.

C. Incoming students from industry who seek to update their skills and/or work toward a professional degree.

D. Returning students.

E. Students who are forced to leave before completing formal 2-year programs.

F. Students seeking Associate degrees.

G. Students planning to transfer to 4-year institutions.

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CHAPTER I

INTRODUCTION

Background of the Problem

There is, at present, a considerable difference of opinion regarding the question of developing the technical curricula in post-high school institutions, in light of local needs as opposed to developing the technical curricula in these institutions in light of national needs. This difference of opinion very often hinges upon whether or not the curriculum developer believes that the recipient of the training will be selling his skills and knowledge on the local market or will be offering his abilities nationally.

The advocates of the local needs theory support their contention--that technical curricula should be developed to meet local needs because technically trained graduates do not move from the area in which they received their training--with such studies by Coe and Zanzalari, 1964; Eninger, 1965, 1966, 1968; and Matteson, 1967.

In the Coe and Zanzalari (1964) study for example, it was found that mobility was not a prevalent form of behavior:

> The lack of mobility comes as a mild surprise. Perhaps we have been misled by all the talk about people moving around like pieces on a chess board. At least insofar as this group (Technical High School graduates) was concerned there was substantiation for the basic tenet of providing vocational training opportunities in terms of local employment needs [p. 25].

The respondents in the national study reported by Eninger (1965, 1966, 1968) also seemed to be resistent to changing location:

> There is very little mobility among vocational course graduates. Less than three percent obtained their first full-time job by moving to another city. Eleven years after graduation, 87 percent still reside and work in the city in which they went to school. Another ten percent have made only one new city move in the eleven year period [1966, p. 2].

Matteson (1967) too, found in his study of selected noncollege bound youth, a resistance to geographic mobility:

> In summary, non-college bound youth in these communities tend to remain near their homes, and enter the range of occupations dictated by the occupational structure of their communities [p. 2].

Outside of the vocational education milieu, others have found incidence of immobility among certain groups. For example, in a study of three different social classes of adults, Reissman (1953) found a similar resistance to geographic mobility:

> This situation appeared to be evident in a group of young men from a Junior Chamber of Commerce. They are well educated and ranked comparatively high in class indices but did not show especially high levels of aspiration. Compared to the young Evanston group, what they expressed was a definite orientation toward their community. They were disinclined to leave their friends, to leave their families, to move around the country, or to leave their community [p. 241].

The effect of these studies on the development of the technical curricula in the post-high school setting has very often been one which has caused the tailoring of course objectives to the needs of the local industries. This point was made in the most recent edition of the Occupational Outlook Handbook (1968). In the handbook it was reported that, "Junior college courses in technical fields are often planned around the employment needs of the industries in their locality [p. 194]."

In summary, what the advocates of the local needs theory have done, is cite a number of major studies which look broadly at the recipients of high school vocational training; and use the findings of these studies to support their contention that vocationally trained individuals don't migrate. Therefore, post-high school technical training should be developed in light of local needs.

On the other side of this issue of determining the direction to be taken by technical curriculum development, are those who contend that technical training in the post-high school setting must be designed in light of national needs as well as local needs. This is necessary, they feel, because people do move around "like pieces on a chess board."

This group too, has amassed an extensive literature. Theirs, however, views this nation's technical work force as a fluid portion of our society. This group not only sees the work force as being geographically mobile, but also sees the worker as moving from employer to employer and even from one occupational classification to another:

> The changing geography of our population and industry are relatively familiar, but with the development of current labor force measures such as the Monthly Report on the Labor Force, new dimensions of mobility began to be documented. It turns out that people not only move with considerable regularity from place to place, but also exhibit a substantial amount of moving around into and out of the labor force. When in the

> labor force, they move into and out of employment and unemployment; and when in employment, into and out of jobs with different employers. Millions of persons change labor force, employment, and employment status each month. Over a year's time, the number changing status is phenomenal, considering the fact that only a few decades ago the labor force was viewed as rather stable, changing slowly in response to population change. There is an enormous amount of shifting around in even a short time, reflecting changes in response to social, economic, and political change, cyclical ups and downs, and seasonal demands by industry, business and agriculture [Wolfbein, 1964, pp. 211-212].

Blau and Duncan (1968) were able to document similar findings in their recent study of the occupational structure of the nation: "With about three-fifths of adult men living outside the community in which they were raised, migration is clearly the prevailing pattern in our industrial society [p. 225]."

Some writers see migration as a pattern of behavior which will expand beyond the national borders. Herbert E. Striner (1968) for example, sees international labor market mobility as a pattern of behavior by 1984.

> In addition to mobility within the United States by 1984, there should also be an increase in the movement of labor forces between nations. Some years ago, in Donald Michael's book Cybernation: The Silent Conquest, I was quoted on the possibility. Let me reiterate the point now. I would guess that no one in this audience would be surprised to learn that, for any one of various reasons, one of his colleagues was going to spend a year or so working in another country.

> By 1984, I would suggest that this type of mobility will hold true for nonprofessional skilled workers as well. A year ago, there was a unique recruitment effort being conducted by the United Automobile Workers. This union sought to recruit older, retiring automotive assembly-line workers for their counterpart jobs on European assembly lines where job openings were in abundance. The response was excellent. I would suggest, that in 17 years, international labor market mobility will be almost as common for the skilled as for the professional workers.

In addition to these general statements regarding the mobility of the work force, specific incidence of migration between areas has been reported in the literature.

Robert Marsh reported in the Social Security Bulletin (1967, p. 15) the following incidence of mobility for periods of one year, five years, twelve-thirteen years, and for a "lifetime":

> One Year. From 5 to 6.8 percent of the population moves from one labor-market area to another in a typical 1 year period. The lower estimate was made by the Survey Research Center on the basis of interviews in 1962 and reinterviews in 1963 with a cross section of the United States population. The higher figure comes from the Bureau of the Census and indicates the proportion of migrants (including those who moved from one country to another within a metropolitan area) for roughly the same period.
>
> Five Years. In recent five year periods (1957-62 or 1958-63), depending on when the interviews took place, the proportion of family heads who moved between labor-market areas was 15 percent, or three times the proportion

> who reported having moved in 1 year's time. Close to a 3-1 ratio was also found by the 1960 Census, which collected data on place of residence in 1955 and was therefore able to make a 5 year comparison. In the latter case, the 5 year mobility rate was 17.5 percent.
>
> Twelve-thirteen Years. In the period of 12-13 years from early 1950 to the date of interview, 29 percent of family heads moved from one labor-market area to another.
>
> Lifetime Mobility. Sixty-eight percent of family heads, or more than 2 out of every 3, were at the time of the Survey Research Center study, found to be living in a labor-market area other than the one in which they were born. Of the remainder, 5 percent reported that one time they had lived elsewhere [p. 15].

Perrella and Waldman (1966) also found that the way in which the American worker exhibits his propensity for change is not just confined to changing geographic location--he also changes jobs. In their study of graduates and dropouts they found that nearly 1.2 million workers, of a sample population totaling over 2.4 million, changed occupational classification within a two-year period.

> Between 1963 and 1965, an impressive amount of occupation change took place among the dropouts and graduates: Half of the number who were employed as of both periods were no longer in the same occupation group in 1965. Graduates and dropouts were equally likely to have changed their occupations. Since each of the major occupation groups includes a wide range of occupations, the number of men who were employed at quite dissimilar kinds

> of work, even though they remainded in the same group, was undoubtedly even larger [p. 863].

The results of these findings on mobility, both geographic and occupational would appear to have some rather important implications for those responsible for developing curriculum.

The United States Department of Labor (1967) gets directly to this point:

> Although training is a local affair and must be planned in the context of local manpower requirements, manpower analysts and education and training authorities must bear in mind that many young persons do not stay in their home communities after receiving their training. The significance of geographic mobility can be illustrated by data from the decennial census which showed that nearly two-fifths of the 18 year olds in 1955 were living in another county five years later and about half of these were living in another state. Moreover, it appears that the proportion of young persons (18-24) migrating to another area is increasing. Thus, state, regional and national trends may have to be considered along with local manpower requirements in planning education and training programs for youth at the local level [pp. 5-6].

In summarizing the problem then, we find considerable data on both sides of the issue of mobility. For the individual who finds himself responsible for developing a particular area of technical training, such as an electronic technology program in a post-high school setting, this array of seemingly contradictory material could present a sizable problem.

On the one hand are those who see technical training as responsible for providing the specific skills and knowledge required of the worker in the local (taxpaying) labor market (Venn, 1964). On the other are those who feel that mobility is decidedly a prevalent pattern of behavior and as such, has implicit implications for the curriculum developer. They feel, that mobility among the technical work force implies the worker will be required to adapt his training (skills and knowledge) to the new environment. Thus, some curriculum developers see implicit in the mobility finding the need for providing broader and more generalizable skills which can be more easily transferred to the individual's new environment. Swanson (1969) applauds this effort in the secondary curriculum.

> Such efforts to generalize the curriculum are laudable. First, they help to identify a national commitment to the work ethic and help mobilize the behaviors in the affective domain toward this commitment in all secondary curriculums. Second, they provide an added dimension to the vocational curriculum which supplements specific skill training [p. 23].

The problem then, to which this study was directed was to determine the mobility behavior, both geographic and occupational, of certified electronic technicians. In making this determination, the study attempted to assess the extent to which the rates of mobility varied both among technicians from various curricula and according to whether the technicians received their training in the high school, post-high school or on-the-job. The instrument used for assessing mobility behavior also provided a measure of the extent to which a change in job required the technician to apply new skills and knowledge to different products and/or services. By providing these assessments, it was felt that the technical curriculum developer would be provided with current and relevant data for making appropriate policy decisions.

Statement of the Problem

The purpose of this study was to provide the electronic curriculum developer with the answers to the following questions:

1. Do the mobility patterns, geographic and occupational, of electronic technicians differ in relation to whether the individual received his technical training in the high school, in the post-high school or on-the-job?

2. Do the mobility patterns, geographic and occupational, of electronic technicians differ from the mobility patterns of other engineering technicians?

The importance of the answers to these questions is spoken to in greater detail on page 24 under Significance of the Study. However, it should be mentioned here that in the absence of specific data to the contrary, curriculum development in the post-high school may develop solely in response to the training needs of local industries. This pattern of curriculum development has been prompted in large part, by studies which have looked only at high school trained technical manpower. Furthermore, if consistencies in mobility behavior is found among the graduates of different technologies, the curriculum developer responsible for determining the course content of a new or emigrant technology could reasonably anticipate the mobility behavior of his graduates and therefore provide the kinds of experiences which they would need.

Prior to this study, if one wished to determine the answers to these questions from the available literature found at either end of the mobile-nonmobile continuum, he would immediately be faced with the problem of validity since both groups of studies have assessed broad occupational areas and did not deal specifically with recipients of electronics training. The Eninger (1965) study for example, assessed the degree to mobility among vocational graduates in all Trade and Industrial areas, while the studies represented by Perrella and Waldman (1966) covered respondents employed across the broader occupational spectrum. As a result, the problem of assessing the mobility patterns of electronic technicians cannot be resolved from the present group of studies.

Since this is the case, and since these questions are essential in determining "predictive curriculums in electronics [Gillie, 1966, p. 16]," this study set out to determine what constituted mobility patterns for certified electronic technicians.

It must be stressed, that this study examined only those engineering technicians who were certified by the Institute For The Certification of Engineering Technicians. This organization is the national certifying agency sponsored by the National Society of Professional Engineers. The extent to which this certification process has been selective of technicians with unique qualities has not been assessed by this study. The reader must consider this limitation in generalizing the results of this research.

This limitation could have been overcome had a comparison group of technicians, (other than certified engineering technicians) been examined simultaneously with those in this study.

Statement of the Hypotheses

The need to determine if certified electronic technicians were mobile, geographically and occupationally, and if this mobility varied according to whether the technicians were trained in the high school, the post-high school, or on-the-job, led to the formulation of the following hypotheses.

$\bar{H}_1$ Differential geographic mobility among certified electronic technicians will be a function of the learning environment in which they receive their training; i.e., certified electronic technicians trained in post-high school institutions will have a higher index of geographic mobility than will those certified electronic technicians who have received their training in either the high school or on-the-job.

$\bar{H}_2$ Differential geographic mobility among certified technicians, other than electronic, will be a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions will have a higher index of geographic mobility than will those certified technicians who have received their training in either the high school or on-the-job.

$\bar{H}_3$ Differential occupational mobility among certified electronic technicians will be a function of the learning environment in which they receive their training; i.e., certified electronic technicians trained in post-high school institutions will have a higher index of occupational mobility than will those certified electronic technicians who have received their training in either the high school or on-the-job.

$\bar{H}_4$ Differential occupational mobility among certified technicians, other than electronic, will be a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions will have a higher index of occupational mobility than will those certified technicians who have received their training in either the high school or on-the-job.

Rationale for the Hypotheses

The hypotheses were a prediction, logically based upon a position derived from the studies which preceded this investigation. The position was: The higher incidence of mobility, geographic and occupational, would be observed among the respondents with the most years of education.

This position was supported by the studies by Blau (1968, p. 113); Perrella and Waldman (1966, pp. 865-866); Duncan and Hodge (1963, p. 644); Crockett (1964, p. 233); Stern and Johnson (1967, p. 4); United States Department of Commerce (1964, p. 30); Marsh (1967, p. 16); and United States Department of Commerce (1964, p. 4). All of these studies found that incidence of mobility increases with the number of years of education. These findings, when compared with the findings of Eninger (1965); Coe and Zanzalari (1964); and Matteson (1967)--that vocational high school graduates don't migrate, caused the experimenter to expect to find support for the hypotheses formulated in this study.

In addition, the direction of the hypotheses was supported from an empirical base which led the experimenter to expect that those individuals who were exposed to the employment opportunities provided by national firms seeking trained personnel would be more apt to have greater incidence of mobility than those sheltered from these employment opportunities. The graduates of a 2-year college for example, were expected to have a wider range of employment possibilities from which to choose than were their high school counterparts. The restricted view of the potential employment opportunities offered the high school graduate was also expected to be operative in the situation of the individual trained on-the-job. In addition to this factor, the individual trained "in house" was expected to be more likely to feel he had an obligation to the firm which had provided his training.

Finally, the experimenter expected that the confidence engendered by the successful completion of a post-high school course of training would enhance the willingness of an individual to take on the challenge of new jobs in new areas far afield from the areas in which he was trained. Thus, the demonstrated ability and its associated motivation was expected to contribute significantly to the mobility of this individual--a rationale consistent with the findings of Crockett (1964).

Operational Definitions

The following words and groups of words were defined for this study:

Subjects. The subjects for this study were the total population of certified engineering technicians employed in the Middle Atlantic States Region (N=1563) during the time of this study (Spring 1969).

Middle Atlantic States Region. New Jersey, New York, and Pennsylvania comprise the Middle Atlantic States Region.

Engineering Technicians. For the purpose of this study the term engineering technician was used as a generic term to describe an individual, with less than a baccalaureate degree,

> who can carry out in a responsible manner either proven techniques which are common knowledge among those who are technically expert in his branch of engineering, or those specially prescribed by professional engineers. Under general professional engineering direction, or following established engineering techniques, he shall be capable of carrying out duties which may comprise: working on design and development of engineering plant; draftsmanship, the erection and commissioning of engineering equipment or structures; estimating,

> inspection and testing engineering equipment; use of surveying instruments; maintaining engineering machinery or engineering services and locating faults; operating, maintaining and repairing engineering plant; or activities connected with research and development, sales engineering and representation, servicing and testing of materials and components, advising consumers; and training and education.
>
> In carrying out many of these duties, the competent supervision of the work of skilled craftsman will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a job in the light of a well-established practice.
>
> An engineering technician, therefore, requires a background sufficient to enable him to understand the reasons and purposes of the operations for which he is responsible. [Institute For the Certification of Engineering Technicians, 1963, p. 4].

Certified Engineering Technician. A certified engineering technician is an engineering technician who has been certified and graded as either a Senior Engineering Technician, an Engineering Technician, or a Junior Engineering Technician by the Institute For The Certification of Engineering Technicians (ICET). For the purpose of clarification the three grades of technicians certified by the Institute carry, in addition to their grade classification, the Roman numeral I for Senior Engineering Technician, II for Engineering Technician, and III for Junior Engineering Technician. This was done in order to differentiate between the broad generic term of engineering technician and the grade classification of Certified Engineering Technician given by the Institute.

> Certified Senior Engineering Technician I
>
> A person who, in addition to possessing the qualifications stated . . . above, has had at least ten years of additional technical experience of a high level detailed technical nature under the direction of a professional engineer or equivalent. Evidence of a satisfactory record shall consist of endorsement by at least three professional engineers or equivalent who have personal knowledge of the education and experience of the applicant. In no case shall a person become a Senior Engineering Technician (I) who is not at least 35 years of age at the time of application for that grade of membership [ICET, 1963, p. 5].
>
> Certified Engineering Technician II
>
> A person who, in addition to possessing the qualifications stated . . . above, (1) has demonstrated technical knowledge at the level of a graduate from an Engineers' Council for Professional Development accredited program in some field of engineering technology, plus at least five years of additional experience under the direction of a professional engineer or equivalent, or (2) he shall be a graduate of an ECPD accredited program plus at least five years of experience under the direction of a professional engineer or equivalent who have personal knowledge of the education and experience of the applicant. In no case shall a person become an Engineering Technician (II) who is not at least 25 years of age at the time of application for that grade of membership [ICET, 1963, p. 5].
>
> Certified Junior Engineering Technician III
>
> A person who is acquiring training and experience to qualify for the grade of Engineering Technician (II). He must have worked at least

> two years during which time he shall have demonstrated elementary technical ability as indicated by endorsement of a professional engineer or equivalent who has personal knowledge of the applicant or he shall be a graduate from an Engineers' Council for Professional Development accredited program in some field of engineering technology [ICET, 1963, p. 4].

Institute For The Certification of Engineering Technicians. The Institute For the Certification of Engineering Technicians (ICET), (hereafter called Institute), was established in 1961 under the sponsorship of the National Society of Professional Engineers as an examining body for determining the competency of those engineering technicians who applied for certification. The competency would be,

> determined through investigation--including recommendations, endorsements, and examinations as appropriate--of the applicant's work experience, character, and knowledge. As evidence of satisfactory attainment, the Institute grants and issues certificates in any of the three grades authorized, (Junior Engineering Technician (III), Engineering Technician (II), Senior Engineering Technician (I)) and also maintains a registry of holders of such certificates [ICET, 1963, p. 3].

Certified Electronic Engineering Technicians. Those engineering technicians who have been certified by the Institute (Grade I, II, or III) and who have identified electronics as their area of specialization (See Question 6 in the Questionnaire, p. 160) were classified as Certified Electronic Engineering Technicians. This classification was shortened to Electronic Technicians.

Employment Task Scale. This was a scale designed (by the experimenter) to assess the degree to which the respondents were working with the theory and tools of their specialization. In addition, it was used to assess the extent to which the respondents were supervising and being supervised in their current job. (See Questions 35-38 in the Questionnaire, p. 167.)

Currently Employed. Technicians were considered currently employed if they were receiving remuneration from a firm for performing the tasks associated with their area of specialization.

Geographic Mobility Index. (Eninger, 1965) The geographic mobility index was the result of the interaction of two elements: (1) how often the technician changed his residence (Intercity Moves, See Question 7 in the Questionnaire, p. 160), and (2) how far in miles he moved.

The equation used to derive this measure is as follows:

$$Mg = N \sum_{i=1}^{n} D_i$$

where M_g = Geographic mobility
N = Number of moves
D_i = The value assigned to the distance moved.

Distance Values = 2 = 50
3 = 51 - 150
4 = 151 - 300
5 = 301 - 600
6 = 601 - 1200
7 = 1201 - 2400
8 = 2401 - 4800
9 = 4801 - 9600 miles.

Occupational Mobility Index. Every change of job recorded by the respondent received an assigned value index which was the result of the interaction of two elements: (1) the degree of change in applied skills and knowledge encountered between jobs, and (2) the degree of change in product or service encountered between jobs. This value was assigned by the respondent himself and converted into an occupational mobility index in the following manner, (See Questions 31-34 in the Questionnaire, p. 165):

$$M_o = (N - 1) \sum (S + P)$$

where M_o = Occupational mobility.
N = Number of jobs held since completion of technical training.
S = Assigned value for the degree of skill and knowledge change.

0 = No change
2 = Somewhat of a change
4 = Considerable change
6 = Complete change

P = Assigned value for degree of product or service change.

0 = No change
1 = Somewhat of a change
2 = Considerable change
3 = Complete change

Electronics Competency. An individual was considered as competent in the field of electronics if he had been certified by the Institute and was receiving remuneration for his work in the area of electronics.

High School Technical Training. A respondent was considered as having received his entry level, technical skill training in the high school, if he answered "yes" to the question: Did you receive your technical training, for the technology in which you are now employed in high school?

On-the-Job Technical Training. A respondent was considered as having received his entry level, technical skill training on-the-job, if he answered "yes" to the question: Did you receive your technical training, for the technology in which you are now employed on-the-job?

Post-High School Training. A respondent was considered as having received his entry level, technical skill training in a post-high school, if he answered "yes" to the question: Did you receive your technical training, for the technology in which you are now employed in a post-high school?

Significance of the Study

The final assessment as to the significance of this study will have to be made by those for whom the findings have relevance. However, it was felt that the rigorously controlled collection and interpretation of the data from this study would contribute to the curriculum development of electronics programs by identifying the extent of the labor market in which the skills and knowledge acquired by the trainee were being sold and determining if this market was consistent across training environments.

If electronic technicians market their training strictly to the local industries then the training experiences being provided should reflect this fact. However, if in addition to local employment, the technician seeks employment in other industries in other areas, the training experiences must provide the opportunities which will enhance this behavior. In addition, the identification and description of the degree to which the technician is required to employ the theory and tools of his specialty, and the extent to which he supervises and is supervised could provide the basis for the logical development of relevant experiences for those planning to enter this field. In an area of specialization which is undergoing dramatic changes in the state-of-the-art, the need for continued and factual assessment of those individuals working in the field is essential if the training programs are to be relevant "for matching people and jobs [Wolfbein, 1964, p. 211]."

Since it was outside the scope of this study to assess all the elements which bear upon the electronics curriculum, the focus was directed at providing the electronics curriculum developer with an accurate assessment of the extent to which the certified electronic technician markets his skills and knowledge on the local market--where he was trained--as contrasted with the national market.

In the absence of such data, the decisions, regarding the direction of the electronics curriculum, have been based upon the findings of studies which may have little relevance to the specific area of electronics, and which may be further limited because of their use of the follow-up design for assessing mobility.

In the Eninger (1968) study, for example, there is little doubt as to the direction being advocated for all high school vocational curriculums:

> If placement of graduates into the field for which trained is to be a major objective, then curriculum planning should be geared to meet local manpower requirements. The data clearly

> indicated that the great majority of vocational graduates do not leave the community in which they went to school. Even the 'address unknown' graduates, when located by intensive search, were found mainly at different addresses in the same communities in which they went to school. Only extremely depressed conditions, where there are virtually no jobs to be had, seem to force movement in the first few years after school. Moreover, those that do move are less likely to find jobs in their field of study than those who stay.
>
> These facts suggest that, until the mobility of vocational graduates changes, vocational educators will do better to concentrate their course offerings to meet the manpower requirements of the functional community served by the school. Common sense may have suggested to (some, the) same conclusion. It is a relatively rare high school graduate who has the maturity and the resources to move away from family, friends and a supportive environment in search of a job many non-commuting miles from home. Educators should not be seduced into adding course offerings on the basis of Department of Labor national manpower requirement forecasts. What are the local requirements? That is the question [p. 2-67].

Interestingly enough, this entire position is based upon mobility findings which could have been interpreted differently, i.e., the direction being advocated by Eninger for developing vocational curriculums is based upon the incidence of mobility recorded among the respondents in a follow-up study which found approximately 2,632 (24.5 percent of the vocational graduates in the initial mailing) nonrespondents to be, "'address unknown' graduates." Even with the five percent correction sample--to which ninety responded--one must question the appropriateness of using this study as a realistic assessment of the degree to which high school trained vocational graduates migrate [Eninger, 1965, pp. 2-26].

Therefore, the study being reported here, in addition to assessing the relationship between mobility and the training environment, has provided an improved methodological design for assessing mobility which avoided the pitfalls of a follow-up design. The respondents functioning as certified electronic technicians in the Middle Atlantic States were asked to record the incidence of mobility they had experienced. This obviously provided a more reliable means for assessing the degree to which certified electronic technicians migrate.

In addition to the internal invalidity which may be associated with the mobility findings of the Eninger study due to the high percentage of "'address unknown' graduates," the curriculum developer is reminded by the data reported here that he must not overlook the fact that there are means by which an electronic technician can obtain his vocational training which are outside the high school, and which may influence his mobility.

CHAPTER II

LITERATURE

The following chapter will attempt to present a resume of the history and present status of the major problem of this study. Briefly stated, this study set out to determine if there was significant differential mobility, geographic and occupational, among electronic technicians trained in high school, post-high school, or on-the-job. The discussion which follows will take the form of a brief critical review of previous investigations of this problem and closely related ones.

The fact that man moves from one location to another has interested researchers for centuries. This interest is an outgrowth of the realization that man's migration has a pronounced effect directly or indirectly upon all aspects of society. Because migration affects the historical, political, economic, educational, social, and ecological structures of every nation, the phenomenon has been examined in great detail by representatives from those areas. To support this contention, one need only review the literature under the heading of "mobility" or any of its appropriate synonyms.

The historical development of the literature relating to the broad topic of mobility points out the changing interest of the serious observer. This interest progressed from a mere counting type of examination of mobility to a search for the factors which might have a greater than chance relationship to the phenomenon. This change in interest reflects, for many, an attempt to uncover a cause-effect relationship.

However, as far afield as one is able to go under the generic term "mobility," one can still delineate his search to more manageable proportions by establishing relevant parameters. Regarding the study being reported here, the literature search centered upon the mobility of the electronic technician trained in the high school, the post-high school, or on-the-job. From this starting point the literature was reviewed in a manner analogous to concentric circles. Hopefully, this resulted in the examination and reporting of the sources having the greatest relevance for the purposes of this study.

Of all the studies examined in the search of the literature, only one was found which related specifically to the target population of the research being reported here.

The United States Department of Labor published the results of a study (USDL, 1954) it had conducted over a twelve-year period on the mobility of electronic technicians. At the time of the study's publication (1954), the electronic technician was thought to be a worker in "a new skilled occupation."

The specific questions for which the USDL study sought answers were:

1. What are the personal characteristics of the workers in (this) occupation; and how will these affect the future supply and mobility of the workers?

2. How do these skilled workers get their training?

3. What are the sources from which fully or partially trained workers may be drawn?

4. How do these workers move between occupational specialities, establishments, industries, and areas; and what factors affect this movement [pp. 2-3]?

The purpose of the study was to examine the characteristics of workers in an occupation considered critical to national defense, so that the information about the personal characteristics, training skills, and job duties of such workers, coupled with data on their past movements between jobs, could be used to prevent crippling manpower shortages in the event of full mobilization [p. 3].

Some of the major findings of the study were:

1. Electronic technicians were a young group of skilled workers, median age 33, who changed jobs relatively often from January 1940 to April-May 1952.

2. The most mobile technicians were young men with only a year or two of experience in the field.

3. Electronics training in technical schools was the most common type of training for this occupation, though many techicians, particularly the older men, had acquired much of their skill at home through reading and hobby work.

4. The average electronic technician changed jobs once every four years during the twelve-year work history covered in the survey.

5. About 55 percent of the respondents had held civilian jobs, other than electronic technician jobs, during the twelve-year period covered in the survey.

6. Sixty-one percent had served in the Armed Forces, half of them serving as electronic technicians.

7. Less than half of the electronic technicians had held the job they were in at the time of the survey for more than 36 months.

8. About 20 percent of the electronic technicians moved from one city to another when changing jobs over the twelve-year period.

9. The majority of the men who took jobs as electronic technicians were high school graduates who had a definite aptitude for mathematics and the physical sciences [pp. 7-12].

These findings were obtained from a personal interview survey of 1,926 electronic technicians employed in eight of the nation's largest metropolitan areas: Atlanta, Baltimore, Boston, Chicago, Detroit, Los Angeles, New York, and Philadelphia.

This study, while containing many essential elements which speak to the problems confronting electronic curriculum developers, and avoiding some of the shortcomings of a follow-up design, did not factor out adequately the manner by which the electronic technician was trained, and, while holding this variable constant, assess differential mobility. It, like the studies of Coe and Zanzalari (1964), Matteson (1967), and Eninger (1968), grouped all vocationally trained respondents together under the broad classification of "trained in technical school." Although the Labor Department study differentiated between civilian technical school, Armed Forces technical school, and part-time technical school, it did not attempt to determine whether those counted as having received their training in the civilian technical school did so at the high school or post-high school level. The use of the data from this study, therefore, aids little in answering this question: Does the post-high school school recipient of technical training manifest the same type of mobility behavior as his high school trained or on-the-job trained counterpart?

Where the Labor Department study did prove helpful for the study being reported here was in its examination of electronic technicians apart from other types of technically trained manpower.

However, the degree to which high mobility does, in fact, imply the application of new skills and knowledge is still unresolved. Although this study did factor out the electronic technician from among "other" technicians and then record the frequency of job changes, it did not examine the degree to which these changes required the electronic technician to apply new or different skills and knowledge in these job changes. For example, it is of critical importance for the curriculum developer to know if the technician was required to apply different skills and knowledge to his new job, when he changed his job from Newark, New Jersey to Philadelphia, Pennsylvania.

The next study which had bearing upon the subject of this research is the Eninger study (1965, 1968). The principal objectives of this study were:

> 1. To describe occupational education and other experiences of vocational graduates.
>
> 2. Describe the process of vocational education; i.e., relevant characteristics of schools offering vocational programs.
>
> 3. Establish the relationships between process and product variables.

The major relevance the work of Eninger had for the study being reported here was his assessment of the degree of geographic mobility experienced by those vocational high school graduates who responded to his Questionnaire.

> The mean number of moves to other cities for graduates of 1953, 1958 and 1962 was .4, .3, .2, indicating very little mobility of vocational graduates. The percentage that move to another city to get their first job is negligible. Of those who do move to other cities, the majority of cases are for distances less than 300 miles [1965, p. 12-0].

The fact that the Eninger study "breaks out" the graduates of 1953, and provides their mean number of intercity moves (.4), allowed a direct comparison to be made between those respondents and the ones being analyzed here.

The principal objections to using the mobility findings of the Eninger study in solving the problems to which the current study was directed were: (1) the Eninger study looks only at high school trained technicians, and (2) it does not examine electronic technicians apart from "other" technicians. The question of whether it is valid for curriculum developers to expect post-high school trained electronic technicians to behave in the same fashion as high school trained electronic technicians was raised in the preceding chapter. However, in spite of these limitations, the Eninger study provided another reference against which the findings of the current study were compared.

The Matteson study "describes the extent to which employment experiences following high school were associated with enrollment in high school--vocational education programs among male graduates of a set of high schools in northeast Wisconsin [Matteson, 1967]."

The relationships studied were "between the number of units of vocational education taken and the nature of (1) initial employment, (2) employment tenure, (3) job advancement, and (4) job satisfaction."

The significance of this study for the problem being examined here lies in the finding that the high school vocational education experiences of the subjects examined were inversely related to mobility. That is, as the number of vocational courses increased mobility decreased.

> Four out of five graduates remained in the communities in which they attended high school. A larger part of those who took three or fewer units of vocational education (the average number of vocational education units for the graduates was four) found employment outside their home communities and usually in jobs of higher prestige [Matteson, 1967, Abstract, p. 3].

Of course, the same caution applies here that applies to all research of this type, i.e., relationships do not necessarily imply causal connections.

The Coe and Zanzalari (1964) study sought to assess the effectiveness of the high school vocational education programs in the Middlesex County (New Jersey) Vocational and Technical High Schools. The principal basis for evaluation was the tenet that "the acid test of the quality of the vocational education program is the placement of students in the occupations for which they receive instruction [Coe and Zanzalari, 1964, p. 1]."

The study examined 98 high school vocational graduates, by mail Questionnaire, ten years after graduation. With 90 percent of the graduates responding, the study found geographic mobility relatively low:

> Certain patterns emerged quite clearly from the geographical data. The female graduates tended to move out of the county as they married and their husbands moved in their jobs. Secondly, some servicemen as they experienced opportunities in other states, remained in other states to take advantage of these opportunities. However, at the time of the study, only fourteen graduates out of ninety-eight or fourteen percent were living outside of the county.
>
> The history of this class is a rather remarkable case of non-mobility. A great deal is said about the mobility of American workers. The evidence does not indicate that this is true of this class. It may suggest that skilled workers of the type represented here tend not to move far from where they were brought up and educated. It may also reflect the rather healthy and stable employment situation in Middlesex County over this ten-year period [p. 24].

In assessing the degree to which the worker who received high school vocational training remained in the trade for which he was prepared, the study found:

> The highest percentage of graduates being placed in the trades trained for was directly

> upon graduation: eighty-one percent. After ten years, sixty percent of those available for employment were working at their trades.

Again, when this study was examined together with the studies of Eninger and Matteson, the data were interpreted as showing the absence of pronounced mobility among individuals who receive vocational training in high school.

However, this study, again, like the studies of Eninger and Matteson, failed to "break out" the graduate who received electronics training and examine him for differential mobility. Although the study was able to assess the number of students who had gone on to some form of post-secondary training, 32 percent, it did not hold this constant when assessing mobility.

From this point on, in the review of the literature, the reader will note that the studies reported begin to become more general in reference to both the target population, electronic technicians, and the study of differential mobility as a function of training location, high school, post-high school, and on-the-job. However, each of the sources cited did contribute essential elements for the background of the problem.

In a study of current employees conducted by the Personnel Division of NASA (Kobus et al., 1967) it was determined that a degree of "in house" mobility existed among the 10 percent random sample of scientific, engineering, and administrative employees. Of the 1,700 employees studied, only 10 percent had moved since becoming part of NASA. This geographic mobility however had occurred mainly as a result of "mass moves accompanying the establishment of new activities and in individual changes in duty station directed by installation managers." Although the study was unable to identify any clear-cut predictors of mobility, it did find that "movers appear to be motivated more by work, job, and career while 'non-movers' seem more concerned by personal considerations, family, geographic preferences, community ties, etc. [p. 7]."

It was also found that most employees in professional/technical occupations (scientists and engineers) moved because they were required to do so while those employed in administration moved on their own [p. 7].

One of the more interesting findings of the NASA study was that most of the employees responding to the study indicated a willingness to move if they could expect to receive a promotion or what was termed, "other substantial career inducement."

Samuel Saben (1964) conducted a study for the Bureau of Labor Statistics comparing unemployed workers with employed workers regarding their geographic mobility over a one-year period. In addition to enumerating intracounty, intercounty, and interstate moves, the study examined a variety of personal characteristics and the relationship these factors had to geographic mobility.

These were some of the major findings of the study:

> 1. Unemployed workers were much more likely to migrate than those who were employed--11 percent of the unemployed moved as compared to 6 percent of employed.
>
> 2. The jobless men who migrated did better than those who stayed behind--75 percent of migrant unemployed were employed after move compared with the 55 percent employment rate of 'unemployed' non-movers.
>
> 3. Migrants, on the average, were younger than non-migrants.
>
> 4. The propensity to migrate varies according to:
>
>   a. Labor force status. Thirty percent of the migrants listed 'to take a job' as the most important reason for moving.

> b. Age. In general, age is one of the strongest determinants of migration. Young men, under 25, had about twice as heavy a representation among migrants . . . .
>
> c. Family head status. The migration rate for men who were family heads (6 percent) was about one-third lower than the rate for other men. However this tendency held true only for persons age 25 and over.
>
> d. Color. Nonwhite men--regardless of employment status--had lower migration rates than whites. However, nonwhite men's movement within a county was considerably greater than white men's.
>
> e. Occupation. Professional and technical workers accounted for 19 percent of the migrants while representing, as an occupational group, only 12 percent of the work force. The researcher felt that this over-representation--in the migrant group--could have been due to: 1) higher educational attainment, 2) greater information about jobs in other areas and, 3) larger, more national markets for their skills [pp. 873-875].

The Saben (1964) study, in addition to providing one-year geographic mobility percentage figures for the nation's workforce--11 percent for unemployed and 6 percent for employed--assessed the relationships among certain characteristics and geographic mobility. However, the study examined only briefly technically trained workers and then, only the occupational group known as professional, technical, and kindred workers.

Furthermore, the study did not assess the frequency of moves an individual experiences within the one-year period.

In another study by Saben (1967) the rate of occupational mobility was estimated for the 70 million men and women employed in January 1966. This study found that about 7.8 percent of the employed workforce were working in occupations different from those in which they had been employed in January 1965.

This study, like his previous study, examined mobility (occupational) relating it to other characteristics. It found that:

a. Labor force status. The shifts from blue-collar to white-collar occupations were relatively uncommon. However, there was considerable movement from blue-collar work to the service occupations. Further, most persons who changed occupations in 1965 also changed their employer or their industry, and often changed both.

b. Age. Sixty percent of those who changed occupations were under 35 years of age. As age increases, occupational mobility rates decline--regardless of sex or color.

c. Family head status. Married men had lower rates than single men.

d. Color. The data indicated a higher occupational mobility rate for Negro men than for white men.

> e. Education. Occupational change occurs least among persons who have completed four years or more of college. Further, persons with eight years or less of education were also found to have a low occupational mobility rate [pp. 31-33].

An examination of the two Saben studies showed that some of the mobility findings were consistent:

> The young were more mobile--geographically and occupationally--than the old; single men were more mobile--geographically and occupationally--than married men; and, non-whites had higher rates of intercounty and occupational moves than whites [Saben, 1964, 1967].

The only inconsistency found was when geographic and occupational mobility rates were compared on the basis of educational attainment. Those with the greater number of years of education were more geographically mobile while the converse was found to be true when occupational mobility was related to this variable. The study of Perrella and Waldman (1966) which looked at the employment experiences of 2.4 million graduates and dropouts between 1963 and 1965 may cast some light on the way in which one can interpret Saben's finding of the inverse relationship between occupational mobility and educational attainment. They found that:

> Whatever measure is used--unemployment rate, earnings, steadiness of employment and so on--the men with more education made greater advances over the 2-year period which elapsed between the two surveys [p. 860].

Perrella and Waldman made another point which should be taken into account, when interpreting occupational mobility rates, concerning the interpretation of the occupational mobility rates usually found in national studies which base their findings on census data. More often than not, the occupational shifts reported are counts of workers changing from one major occupational group to another. These interoccupational group changes will not reflect the mobility within occupational groups, and, consequently, the interpretation of the research findings are apt to be extremely conservative.

In their study, Perrella and Waldman (1966, p. 863) qualify their findings in order to avoid this problem of underestimation.

> Between 1963 and 1965, an impressive amount of occupation change took place among the dropouts and graduates: Half of the number (1.2 million) who were employed as of both periods were no longer in the same occupation group in 1965. Graduates and dropouts were equally likely to have changed their occupations. Since each of the major occupation groups includes a wide range of occupations, the number of men who were employed at quite dissimilar kinds of work, even though they remained in the same occupation group, was undoubtedly even larger. The major occupation group, operatives, for example, includes such diverse work as assembler, truck driver, and meatcutter.

The relative size of the workforce which can be expected to change jobs within a broad occupational group was provided by a study of the occupational history of 804 men. This study reported in the Journal of Counseling Psychology (Roe et al., 1966) found that, "The occupational changes of 804 men over periods ranging up to 22 years followed the expectation: when they changed jobs they were most likely to change within one Group (68 percent) . . . ." It should be noted, that the word "Group," used in connection with the source cited above, is the Roe classification Group; and, although it contains similar elements, it is not the same classification as that used by the Department of Labor to subdivide the workforce. The Roe study substantiated the contention that a sizable number of men, when they change jobs, change to similar forms of employment. This finding provided more empirical support for expecting intraoccupational group mobility to be larger than, and in addition to, the reported interoccupational group mobility.

Although the study reported here did not intend to examine variables outside the three levels of the independent variable--high school, post-high school, on-the-job--certain relationships between demographic data and the dependent variables were tested. Since these relationships were observed, and since they will be discussed briefly in another section of this report, it was felt that some attention should be given to examining what others have reported in the literature.

As previously stated, researchers, examining the phenomenon of mobility, have on numerous occasions sought to identify a relationship between mobility and other characteristics.

The following reports, in addition to those already mentioned, spoke to the success of this endeavor.

Lansing (1964), in an attempt to determine why workers moved, found that noneconomic and non-occupational factors played an important role in motivating moves. Blau and Duncan (1967), in an extensive analysis of the American occupational structure, found:

> Occupational opportunities will unquestionably continue to vary substantially in different places, and they will continue to change as new industries develop in some urban centers and technological advances make the industrial activities in another obsolete. These variations give men incentives to migrate from areas with lesser to areas with better opportunities, and the flow of migrants from disadvantaged environments acts as a catalyst for occupational mobility [p. 427].

Pierson and Miller, in a paper presented at the 1967 Indiana Manpower Research Conference, stated that information programs about job vacancies in other areas might correct the labor imbalance among labor markets by affecting mobility [p. 151].

This contention was built upon orthodox economic theory which stated "differences in net economic advantages, chiefly differences in wages, are the main cause of migration . . . movement between areas, like movement between employers . . . stems from a lack of adequate economic opportunity [Reynolds, 1951, p. 242]."

At this point, one might logically ask if there is a consistency between aspects of mobility behavior, i.e., is a man who is occupationally mobile likely to be geographically mobile? Lipset and Bendix (1959) found that there was a consistency among movers: "there is a high degree of association among mobility roles of different kinds. Men who are mobile in one respect (e.g. shifting jobs) are also likely to be mobile in other respects [p. 160]."

In a study conducted by Robert Marsh (1967) the determinants of geographic mobility were found to be:

> personal economic incentives, economic differences between labor market areas, family and community ties, vested interests in home ownership, pension plans and

> unemployment insurance, and individual psychological characteristics [p. 16].

A 1964 summary report of the United States Department of Commerce found that,

> Young people are more mobile geographically than old people; highly educated people are more mobile (geographically) than poorly educated; people in high status occupations have high mobility rates; and, Negroes in recent years have been less mobile between labor markets than whites [p. 4].

Batchelder (1965), like Pierson and Miller (1967), felt information about job opportunities in other areas was a critical factor in the mobility roles of workers. In a study he conducted of approximately 300 unemployed workers in Ohio he found that:

> the information void stands in the way of mobility, for few of the men in either area (Athens or Youngstown) seemed able to assess the availability of jobs even in their own line of work in other regions. Increased geographic mobility should follow from increased knowledge of job opportunities in other regions [p. 532].

Crocket (1964) found differential occupational mobility to be associated with what he called "strength of achievement motive" as measured by the thematic appreception technique developed by McClelland et al. Although he found some college education enhanced the likelihood of upward occupational mobility, he felt the strength of achievement factor to be more significantly operative [p. 242].

In summary, the preceding discussion of the literature represents an attempt to: (1) critically review those studies which have the greatest relevance for the problem being examined here, (2) examine some of the general mobility studies from which curriculum developers, especially those responsible for the electronics curriculum, are apt to take mobility findings, (3) assess the degree to which mobility findings were consistent among various studies, (4) examine the number, kind, and consistency of factors found to be related to mobility.

It would appear that there are no studies which deal directly with the problem examined here. However, those studies which have the greatest relevance, when taken in total, contribute enough data to provide a significant "bench mark" against which the findings of this research can be compared.

The review of the literature has called attention to the need for careful assessment and interpretation of mobility findings.

The apparent danger in interpreting the findings of the various studies is that one may be unduly influenced by the descriptive adjectives of a particular researcher as he equates his findings to some, very often nebulous, "bench mark," and assesses these findings as having shown outstanding, considerable, fairly high, minimal, limited, or negligible mobility. To bear out this contention, the reader is referred to the following studies: Department of Labor (1954) "Electronic Technicians changed jobs frequently [p. 29];" Eninger (1965) "Vocational graduates do not do much moving from employer to employer [p. 34];" Coe and Zanzalari (1964) "The lack of mobility comes as a mild surprise [p. 25];" Kobus (1967) "From the Agency managers' view there has been insufficient purposeful mobility between installations and institutional organizations [p. 8];" and Saben (1964) "The United States has from its beginning been a nation with a mobile population [p. 873]."

In two of the above studies, the description of the mobility found could be rated as high (Department of Labor, Saben), while the remaining three studies could be assessed as having found little or no mobility. However, after analyzing the data, one finds a considerable amount of agreement among the study findings. For example, in the Department of Labor study (1954) the rate of job change reported as being "frequent" was somewhat less than the rate reported by Eninger as being "relatively little." The rates were .25 and .30, respectively. When the same comparison is made between the Kobus (1967) study "insufficient purposeful geographic mobility" and the Saben (1964) study "a mobile population" the rates are (in terms of the percentage of the group who moved) 10 percent and 6 percent, respectively.

Thus, it can be seen that the mobility findings reported in a particular study were interpreted by the researcher in a relative fashion; and, consequently, those who expect to use such findings should be cautioned to examine the data critically and assess carefully its relevance for their particular needs.

CHAPTER III

METHODS

Subjects

There were 1,563 certified engineering technicians included in the original mailing of the survey Questionnaire. This group made up the entire population of certified engineering technicians employed in the Middle Atlantic States Region--New Jersey, New York, and Pennsylvania. The list of technicians living in this region was obtained from the Institute for the Certification of Engineering Technicians. In addition to providing the list of subjects for this research, the endorsement of the Institute, along with six other agencies, was sought for the purpose of increasing the percentage of returns. The other agencies were: The American Society of Agricultural Engineers, the American Society of Tool and Manufacturing Engineers, The Instrument Society of America, The National Aeronautics and Space Administration, The State of New Jersey Department of Education, Division of Vocational Education, and The State of New Jersey Department of Labor and Industry.

Although the group of technicians examined was expected to be representative of all engineering technicians, it should be remembered that there is a possibility that the certification process itself may have provided a selection bias which restricts the generalizations of this study. For example, a bias may have arisen from the fact that the certified engineering technician, in order to have been considered for certification, must have voluntarily petitioned the Institute for certification. However, assessing the degree to which the certification process was selective of engineering technicians with certain characteristics was beyond the scope of this study. Consequently, those for whom the data have relevance will have to interpret the findings in light of this possible restriction.

The actual number of usable responses from which the data for this study were gathered was 668 (See Table 1, p. 54). From this group, 143 were classified as electronic technicians, while 525 were classified as "other." This classification was assigned according to the manner in which the respondent answered Question 6 of the Questionnaire (What is your area of specialization?). In addition to using Question 6 for classification purposes the statement provided by the

TABLE 1

NUMBER AND PERCENTAGE OF RETURNS

Total Sample Contacted	Usable Returns		Unusable Returns		Non Respondents		Follow-up Returns		Total Returns	
	N=	%[a]	N=	%[a]	N=	%[a]	N=	%	N=	%[a]
1563	668	42.7	144	9.2	683	43.7	68	4.4 82.9[b]	880	56.3

Note:

[a] - Percentage computed on Total Sample size (N=1563)

[b] - Percentage computed on size of Follow-up group (N=82)

respondent in answer to Question 39 was also used to verify the assigning of subjects to the proper technical classification. A complete list of the technologies represented by the respondents can be found on page 168 of the Appendix.

Table 1 also shows the number of returns which could not be used in the study because they failed to meet the minimum requirements. These requirements were:

1. The respondent must not have held, at the time of the survey, (October 1, 1969--December 31, 1969), a Bachelor's degree (Question 12E).

2. The respondent must have identified the manner by which he received his technical training (Questions 12, 18, and 19).

3. The respondent must have identified his area of specialization (Questions 6 and/or 39).

4. The respondent must have held, at some time, at least one full-time job. Some respondents, although certified, had remained in school and consequently had never been employed in a full-time position (Questions 29 and 30).

Of the 144 unusable returns, only one was discounted for reasons other than those listed above. In that instance, the technician had died.

The portion of the total sample which was classified as nonrespondents was 765 or 48 percent of the original population. It was from this group that the follow-up selection was made. Each of the 765 nonrespondents was assigned a number and his selection for inclusion in the follow-up group was made by means of the Table of Random Numbers. The number of subjects identified for follow-up was 82; and, from this group, 68 returned Questionnaires. Of the 68 Questionnaires returned, (82.9 percent), 66 were usable. After combining the usable responses (668), unusable responses (144), and those returned in the follow-up (68), the study had a total return of 880 or 56.3 percent.

It should be pointed out, however, that the data on which this study was based were taken from the 668 usable responses. The data obtained in the follow-up were used to assess only the degree to which the nonrespondents were similar to or differed from the respondents.

In Table 2, page 57, the respondents have been classified according to sex, age, veteran status, and mean years of certification. It can be seen that the similarity between electronic technicians and "other" technicians was quite consistent: the percentage of

TABLE 2

FREQUENCY AND PERCENTAGE OF ELECTRONIC AND "OTHER" TECHNICIANS BY SEX, AGE, VETERAN STATUS, AND MEAN YEARS OF CERTIFICATION

Area of Technical Specialization	Male		Female		Age	Veteran		Length of Certification
	f	%	f	%	$\bar{x}$	f	%	$\bar{x}$ years
Electronics	142	99.3	1	.7	33.8	96	67.1	3.6
"Other"	520	99.0	5	1.0	35.9	276	52.6	3.7

males responding--(99.3 percent of electronic technicians and 99.0 percent for "other" technicians); mean age at the time of the survey (33.8 years for electronic technicians and 35.9 years for "other" technicians); and, veterans' status. Sixty-eight percent of electronic technicians were veterans, while 53.1 percent of "other" technicians had previous military service. The mean number of years of certification recorded by the electronic technicians and "other" technicians were 3.6 and 3.7, respectively. The Institute has certified engineering technicians since its establishment was authorized by the National Society of Professional Engineers in 1961.

In addition to classifying the respondents according to the characteristics discussed above, the study examined the subjects according to the states in which they were living at the time the mailing list was completed, and the manner in which they were trained, (See Table 3, page 59).

Some of the respondents (N=7) moved between the time the mailing list was compiled (May 1969) and the time the Questionnaire was sent (October 1969). These respondents were considered, for the purposes of this Table, to not have moved. However, this was the only area where this qualification applied.

TABLE 3

FREQUENCY AND PERCENTAGE OF ELECTRONIC AND "OTHER" TECHNICIANS RESPONDING BY STATE* AND TYPE OF TRAINING

New Jersey

Area of Technical Specialization	High School		Post-High School		On-the-Job		Total Residing	
	f	%	f	%	f	%	f	%
Electronics	1	.7	13	9.1	3	2.1	17	11.9
"Other"	7	1.3	49	9.3	11	2.1	67	12.8

New York

Area of Technical Specialization	High School		Post-High School		On-the-Job		Total Residing	
	f	%	f	%	f	%	f	%
Electronics	5	3.5	46	32.2	4	2.8	55	38.5
"Other"	16	3.0	169	32.2	35	6.7	220	41.9

TABLE 3 (Continued)

Area of Technical Specialization	Pennsylvania							
	High School		Post-High School		On-the-Job		Total Residing	
	f	%	f	%	f	%	f	%
Electronics	8	5.6	56	39.2	7	4.9	71	49.7
"Other"	28	5.3	159	30.3	51	9.7	238	45.3

Note:

*Seven technicians had changed states between the time the mailing list was compiled and the time the Questionnaire was sent. These moves were ignored in the development of this Table. However, this was the only area where this qualification applied.

Table 3 also shows a considerable consistency between electronic technicians and "other" technicians concerning the dimension of residence and type of training. A percentage comparison of the type of training for the two groups, those trained in high school, post-high school, or on-the-job, shows only slight differences.

In conclusion, an analysis of the subject's demographic data points up a striking similarity between electronic technicians and those technicians working in other areas. The technicians involved in this study could be broadly classified as young post-high school trained (74 percent) males, half of whom had served in the military, and, at the time of the study, were residing and working in New Jersey, New York, and Pennsylvania, in the ratio of 1:3.2:3.7. The population ratio for the same states in 1967 was 1:2.6:1.7 [U.S. News and World Report, 1968, p. 77].

Tasks

The subjects in the study were asked, by letter of transmittal (p. 1 of Questionnaire), to complete the four-page Questionnaire shown on page 160 of Appendix A. The exception to this procedure was made in the follow-up study. In this instance, the respondents were told they need only answer Questions 5, 6, 7, 17, 18, 19, 20, 29, 30, and 31. This, it was felt, would increase the rate of return, which apparently it did (84 percent as opposed to 56.3 percent), and still allow for a comparison of those items related to the hypotheses.

Independent Variable

There was one independent variable examined in this study in order to determine the relationship it had to the geographic and occupational mobility (dependent variables) of electronic and "other" technicians living and working in the Middle Atlantic States Region. This variable was the manner in which technical training was received. The three levels of this variable were: high school technical training, post-high school technical training, and technical training which was received on-the-job.

The assessment, as to the type of training environment, was determined from the way in which the subject responded to the following questions: Did you receive your technical training, for the technology in which you are now employed, in high school? If No, did you receive your technical training, for the technology in which you are now employed in a post-high school?

If No, did you receive your technical training, for the technology in which you are now employed on-the-job?
If No, please explain how you received your technical training.

Dependent Variables

There were two dependent variables in this study, geographic mobility and occupational mobility.

Geographic Mobility

The measure of the geographic mobility of a respondent was determined by multiplying the number of new city or town moves by the sum of the distance values assigned for each of these moves. The number of moves was assessed from the time the respondent completed high school to the time of the study, (See Question 7 of the Questionnaire). In order to assure reasonable accuracy of this count, the response recorded for Question 8B (Dates When Enrolled in High School) was checked for those respondents who did not complete high school--four electronic technicians (2.8 percent) and twelve "others" (2.3 percent). The number of moves for these respondents were counted from the time they left school to the time of the study. For an explanation of the formula used to derive this index value the reader is referred to page 21.

Occupational Mobility

The occupational mobility value for each respondent was computed by summing the values assigned by the respondent to a particular job change (A and B of Questions 31, 32, 33, and 34), and multiplying this sum by one less than the number of different full-time jobs recorded in Questions 29 and 30.

This technique provided for weighting of job changes. This weighting was a function of the extent to which the change required the respondent to apply new skills and knowledge to new products and/or services. For an explanation of the formula used to derive this index value the reader is referred to page 22.

Procedure

The order of relevant events which led to the completion of this study started with the piloting of the original Questionnaire in the Spring of 1969.

The pilot study was conducted in New Jersey among a small group of technicians (12 electronic and 13 "others"). The principal purpose of the pilot study was to assess the degree to which the Questionnaire would, in fact, obtain the data necessary to test the hypotheses. Each member of the pilot group was asked to identify questions which he felt were, (1) too personal, (2) too ambiguous, (3) requiring too much time to answer, (4) too vague, or (5) seemed inappropriate in terms of his perceptions of the intent and purpose of the study. The results of this pilot study contributed greatly to the final development of the Questionnaire.

Having developed the content of the Questionnaire, the next step was the determination of the most appropriate format for insuring maximum returns. To this end, the studies of Fry (1934), Moser (1958), Paten (1958), Wormser et al. (1951), and Young (1939) were applied. They suggested the color of the Questionnaire, flavor of the letter of transmittal, the second mailing schedule, and the use of commemorative stamps. Unfortunately, it was outside of the purpose of the study to assess the degree to which these suggestions, and others, improved the rate of return.

The chronology of the second mailing and the follow-up were a function of the rate at which the returns were received. The initial mailing was made in October of 1969. The second mailing was initiated four weeks later when the rate of return from the first mailing had substantially diminished. The follow-up took place in December 1969 and was completed before January 1, 1970.

Data Analysis

In order to test the null of the stated hypotheses, the means calculated for the geographic mobility and occupational mobility of electronic technicians and "other" technicians were compared to determine if the differences observed were significant at the .05 level of probability. The two statistical methods used were the one-way analysis of variance and the Mann-Whitney U-test.[1] The use of a nonparametric statistic (Mann-Whitney U-test) was necessary for four of the mean comparisons because the variance of these groups was such that the assumption prerequisite for the use of the one-way analysis of variance (homogeneity of variance) was not satisfied.

The mean comparisons which were made were as follows:

$\bar{X}$ Mg for ET in High School vs. ET in Post-High School*
$\bar{X}$ Mo for ET in High School vs. ET in Post-High School

$\bar{X}$ Mg for "Other" in High School vs. "Other" in Post-High School*
$\bar{X}$ Mo for "Other" in High School vs. "Other" in Post-High School

---

[1] For a listing of the various statistical tests used and the rational behind their selection. See Appendix C.

$\bar{X}$ Mg for ET in High School vs. ET On-The-Job
$\bar{X}$ Mo for ET in High School vs. ET On-The-Job

$\bar{X}$ Mg for "Other" in High School vs. "Other" On-The-Job*
$\bar{X}$ Mo for "Other" in High School vs. "Other" On-The-Job

$\bar{X}$ Mg for ET in Post-High School vs. ET On-The-Job*
$\bar{X}$ Mo for ET in Post-High School vs. ET On-The-Job

$\bar{X}$ Mg for "Other" in Post-High School vs. "Other" On-The-Job
$\bar{X}$ Mo for "Other" in Post-High School vs. "Other" On-The-Job

Mg = Geographic Mobility
Mo = Occupational Mobility
ET = Electronic Technician
"Other" = Other Technicians
* = Significant Unequal Variance at the .05 level

In addition to a comparison of the means, all possible interrelationships were determined by the use of the correlation statistic (Pearson Product-Moment Correlation).

The variables examined (all technicians taken together) were: Geographic Mobility, Occupational Mobility, Age, Years of Education, Number of Nontechnical Jobs, Number of Technical Jobs, Number of All Types of Jobs, Number of Employers, Number of Intercity Moves, and The Assigned Distance Value (Table 6, page 75).

Finally, using the Mann-Whitney U-test, the mean mobility scores of the principal group and the follow-up group were compared to determine if the nonrespondents could be assessed as "different" from the respondents (Table 7, page 77).

CHAPTER IV

RESULTS

Hypothesis 1

Differential geographic mobility among certified electronic technicians will be a function of the learning environment in which they receive their training; i.e., certified electronic technicians trained in post-high school institutions will have a higher index of geographic mobility than will those certified electronic technicians who received their training in either the high school or on-the-job.

Table 4, page 70, shows that although the mean geographic mobility for post-high school trained electronic technicians was larger (30.7) than the means of both the high school trained (10.8) and the on-the-job trained (11.3) technicians, the difference was not significant at the .05 level when analyzed by the Mann-Whitney U-test and the one-way analysis of variance. Therefore, the data did not support Hypothesis 1; and it was rejected.

TABLE 4

COMPARISON OF THE MEAN GEOGRAPHIC MOBILITY FOR TECHNICIANS TRAINED IN HIGH SCHOOL, POST-HIGH SCHOOL, OR ON-THE-JOB

Area of Technical Specialization	Type of Training						Statistical Tests	
	High School		Post-High School		On-the-Job		One-Way Analysis of Variance	Mann-Whitney U-Test
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	F Score	Z Score
Electronics	10.8	14	30.7	115			____[a]	-1.07
"Other"	10.9	51	21.7	377			____[a]	-1.33
Electronics	10.8	14			11.3	14	0.006	
"Other"	10.9	51			23.2	97	____[a]	-0.53
Electronics			30.7	115	11.3	14	____[a]	-1.47
"Other"			21.7	377	23.2	97	0.03	

Note:

[a] A Parametric Test could not be used in this comparison of the means due to the absence of homogeneity of variance.

Hypothesis 2

Differential geographic mobility among certified technicians, other than electronic, will be a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions will have a higher index of geographic mobility than will those certified technicians who have received their training in either the high school or on-the-job.

Table 4, page 70, shows that although the mean geographic mobility of "other" technicians trained on-the-job (23.2) was larger than the means of both the high school trained (10.9) and post-high school trained technicians (21.7), the difference was not significant at the .05 level when analyzed by the Mann-Whitney U-test and the one-way analysis of variance.

As a result of this analysis, Hypothesis 2 was rejected.

Hypothesis 3

Differential occupational mobility among certified electronic technicians will be a function of the learning environment in which they receive their training; i.e., certified electronic technicians trained in post-high school institutions will have a higher index of occupational mobility than will those certified electronic technicians who have received their training in either the high school or on-the-job.

Table 5, page 73, shows that the mean occupational mobility of post-high school trained electronic technicians (25.3), although less than that recorded for high school (28.4) and on-the-job trained electronic technicians (38.4), was not found to be significantly different at the .05 level when analyzed by the one-way analysis of variance.

This analysis led to the rejection of Hypothesis 3.

Hypothesis 4

Differential occupational mobility among certified technicians, other than electronic, will be a function of the learning environment in which they receive their training; i.e., certified technicians, other than electronic, trained in post-high school institutions will have a higher index of occupational mobility than will those certified technicians who have received their training in either the high school or on-the-job.

TABLE 5

COMPARISON OF MEAN OCCUPATIONAL MOBILITY FOR TECHNICIANS TRAINED IN HIGH SCHOOL, POST-HIGH SCHOOL, OR ON-THE-JOB

Area of Technical Specialization	Type of Training						Statistical Tests
	High School		Post-High School		On-the Job		One-Way Analysis of Variance
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	F Score
Electronics	28.4	14	25.3	115			0.05
"Other"	33.1	51	24.4	377			1.88
Electronics	28.4	14			38.4	14	0.28
"Other"	33.1	51			22.1	97	3.13
Electronics			25.3	115	38.4	14	0.82
"Other"			24.4	377	22.1	97	0.25

By referring to Table 5, page 73, it can be seen that although the mean occupational mobility for high school trained technicians (33.1) is larger than the mean for both post-high school (24.4) and on-the-job trained technicians (22.1) the difference is not significant at the .05 level when analyzed by the one-way analysis of variance.

The result of this comparison of the means resulted in the rejection of Hypothesis 4.

Correlations

An attempt was made in this study to analyze the ten characteristics previously mentioned to uncover any significant linear relationships. The results of these analyses are presented in Table 6, page 75. Using the correlation classification of Koenker (1961), it can be seen that "significant" linear relationships were found between; (1) the total number of jobs held by all technicians and the number of technical jobs held (0.94), (2) the total number of all jobs and the individual's occupational mobility (0.76), (3) the number of technical jobs and occupational mobility (.072), (4) the number of technical jobs and the number of employers (0.67), (5) the total number of jobs and the number of employers

TABLE 6

INTERCORRELATION COEFFICIENT OF VARIABLES

Variables	Geographic Mobility	Occupational Mobility	Age	Years of Education	No. of Nontechnical Jobs	No. of Technical Jobs	No. of All Jobs	No. of Employers	No. of Intercity Moves	Assigned Distance Value
Geographic Mobility		.20	.06	.02	.14	.14	.18	.20	.78	.86
Occupational Mobility	.20		.21	.06	.22	.72	.76	.58		
Age	.06	.21		.33	.04	.30	.30	.14		
Years of Education	.02	.06	.33		.05	.07	.08	.01		
No. of Non-technical Jobs	.14	.22	.04	.05		.04	.30	.09		
No. of Technical Jobs	.14	.72	.30	.07	.04		.94	.67		
No. of All Jobs	.18	.76	.30	.08	.30	.94		.67		
No. of Employers	.20	.58	.14	.01	.09	.67	.67			
No. of Inter-city Moves	.78									.89
Assigned Distance Value	.86								.89	

(0.67), (6) the number of intercity moves and geographic mobility (.078), (7) geographic mobility and the assigned distance value (.086).

Follow-up

Table 7, page 77, shows the results of comparing the representatives of the nonrespondents (the follow-up group) with the respondents. In assessing the geographic and occupational mobility means of the two groups with the Mann-Whitney U-test, it was found that there was a significant difference between the geographic mobility means of post-high school trained electronic technicians in the follow-up group ($\bar{x}$ = 5.6) and the major group ($\bar{x}$ = 30.7). However, this was the only mean comparison which did show significance. The reader will note that only seven comparisons were made, due to the absence of respondents in certain categories.

Ex Post Facto Analyses

Chi-square analyses were performed to determine if significant relationships existed between the expected and observed frequency of the following variables:

1. Number of intercity moves (0, 1-2, 3+) and type of training (post-high school and other than

TABLE 7

FOLLOW-UP GROUP COMPARED WITH SAMPLE GROUP

Area of Technical Specialization	Sample Group					
	School		Post-High School		On-the-Job	
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
					GEOGRAPHIC MOBILITY	
Electronics						
High School	10.8	14				
Post-High School			30.5	115		
On-the-Job					11.3	14
"Other"						
High School	10.9	51				
Post-High School			21.7	377		
On-the-Job					23.2	97
					OCCUPATIONAL MOBILITY	
Electronics						
High School	28.4	14				
Post-High School			25.3	115		
On-the-Job					38.4	14
"Other"						
High School	33.1	51				
Post-High School			24.4	377		
On-the-Job					22.1	97

TABLE 7--Continued

Follow-Up Group						
School		Post-High School		On-the-Job		Mann-Whitney U-Test
$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	
--	--					----
		5.6	9			-2.17*
				--	--	----
--	--					

		22.6	47			-1.84
				29.0	6	-0.23
--	--					----
		15.3	9			-0.55
				--	--	
9.0	3					-1.40
		19.4	47			-0.93
				9.3	6	

Note:

*Significant at the .05 level (Mann-Whitney U-Test) post-high school).

2. Number of intercity moves (0, 1-2, 3+) and number of job changes (0, 1-2, 3+).

In the first analysis, no significant differences between the observed frequencies and the expected or chance frequencies at the .05 level could be found. This lent further support to the rejection of Hypotheses 1 and 2.

In the second analysis, a significant difference was found between the observed frequencies and the expected or chance frequencies at .001 level. This analysis provided support for the contention that there is a significant relationship between geographic changes and occupational changes.

CHAPTER V

ADDITIONAL RESULTS AND DISCUSSION

In Chapter I it was stated that the principal purpose of this study was to assess the degree to which differential mobility, geographic and occupational, was a function of the type of environment in which the certified electronic technician was trained: high school, the post-high school, or on-the-job. In addition, as this study developed it seemed appropriate to examine the extent to which technicians, taken together as an occupational group, demonstrated mobility behavior which was different from other occupational groups and the population in general.

Furthermore, this study attempted to assess the degree to which certified electronic technicians were different from "other" certified technicians. Additional questions for which answers were sought were: (1) Was the mobility behavior of the technician related to such factors as age and years of education? (2) What was the rate of residence and job change experienced by technicians? (3) Did technicians, in changing jobs, leave their area of specialization and return? (4) Did technicians, in changing jobs encounter different products and services which required them to apply different skills and knowledge? (5) To what extent did a change in job involve a change in employer? (6) To what extent were the technicians in this study employing the theory and tools of their technology? (7) To what extent were the technicians in this study supervising and being supervised? (8) What percent of the technicians employed in a state had been trained in that state? (9) What was the nature of the high school preparation of the technician in this study? (10) What percentage of the technicians were continuing their training? (11) What was the most common type of training environment for technicians?

In providing answers to these questions, it was hoped that the individual responsible for developing and/or updating electronics curricula would be able to determine, more accurately, the extent and nature of the labor market being served by the recipients of his training. The result of this labor market assessment promised to provide significant insight into whether the learning experiences provided in a classroom should be tailored to meet local industrial demands or should be more broadly based to insure greater flexibility in job procurement. Also, by assessing the extent to which electronic technicians manifest behavior different from other technicians, the electronics curriculum developer could test the appropriateness of using results of broad-based studies, which looked at all types of technicians, for his own area of specialization. In addition, it was hoped that the curriculum specialist would also know, with a greater degree of reliability than he currently has, if he could apply the findings of studies, which look more narrowly at vocational education, to his own particular curriculum needs.

Having reiterated the objectives of this study, the procedure will be in this chapter to discuss the findings as they relate to these objectives. In order to provide a clear and systematic means for achieving this, this discussion is divided into five sections. The first and second sections will examine geographic and occupational mobility, respectively. The third section will summarize and interpret the demographic findings obtained from the study. The fourth section will look at the training background of the technicians. The fifth section will summarize the preceding four, and it will discuss the major implications for technical curriculum development which have grown out of this study.

Section I - Geographic Mobility

The method used to compute the geographic mobility index for each of the respondents in this study was discussed in considerable detail on page 21. Briefly, the index number was the product of the number of intercity moves times the sum of the values assigned for the distances moved ($M_g = N\sum_{i=1}^{n} D_i$). It was the comparison of these products which formed the basis for the following discussion.

The findings in this study led to the formulation of the following conclusions regarding geographic mobility:

Conclusion 1. Differential geographic mobility was not significantly related (at the .05 level) to the learning environment in which technicians--electronic and "other"--received their training.

Conclusion 2. Electronic technicians were quite similar in terms of the variables examined, to "other" technicians.

Conclusion 3. Taken as a group, all the technicians in this study averaged about two residence changes during their "work history." One of these changes involved the crossing of a state border.

Conclusion 4. The subjects in this study, whether compared to vocational graduates or to the general population, had experienced greater geographic mobility.

Conclusion 5. Geographic mobility was not found to have a significant linear relationship to either the age or the educational attainment of the technicians in this study.

Conclusion 6. One-third of the technicians in this study could be broadly classified geographically as non-movers, one-third as moderate movers (1-2 moves), and one-third as extensive movers (3 or more moves).

From Table 4, page 70 it has been shown that, although the mean geographic mobility index for the various categories had some variation, no statistically significant differences, at the .05 level, could be found. This finding was consistent for both electronic technicians and the group of technicians classified as "other." In addition to finding a similarity in the geographic mobility behavior of technicians from different training environments, a similar consistency in behavior was found to exist between groups of technicians. It was the assessment of these consistencies in behavior--among types of training and between groups of technicians--which led to the rejection of Hypotheses 1 and 2 and the subsequent formulation of Conclusions 1 and 2.

In an attempt to determine if the small number of respondents classified as electronic technicians trained in high school (N=14) and on-the-job (N=14) accounted for the fact that no statistical significance could be found between the means of 10.8 and 30.7 and 11.3 and 30.7, respectively, the chi-square analysis was employed. In this ex post facto analysis the cells were collapsed in order to increase the N. This reduction of cells resulted in a dichotomous comparison between all technicians trained in high school and on-the-job (N=176), and all technicians trained in post-high schools (N=492). The comparison was made between the expected frequency and observed frequency for those classified, within the two groups, as having 0 moves, 1-2 moves, and 3 or more moves. The observed value of chi-square (2.15) was not greater than the .05 level of probability (5.991) with two degrees of freedom. Therefore, the difference between the observed frequency and expected or chance frequency was not found to be significant. This finding provided additional support for rejecting Hypothesis 1.

Prior to performing the chi-square analysis, and, in order to test the appropriateness of using numbers of intercity moves as an indicator of mobility, a correlation coefficient was calculated between the number of intercity moves and the geographic mobility index for all technicians. A marked relationship (.78) was found to exist between the two variables (Table 6, page 75).

In Table 8, on page 87, a more detailed breakdown of the actual number of moves is provided. It can be seen that, taken as a group, electronic technicians have experienced, over their working lifetimes, approximately two moves. One of the two moves involved crossing a state border. The reader will note that the frequency of interstate moves was slightly more intense for electronic technicians trained in the post-high school. The group of technicians classified as "other" have experienced changes in residence at a rate which was somewhat less than that experienced by electronic technicians.

In order to provide a "bench mark" against which this mobility finding could be compared, and thus

TABLE 8

MEAN NUMBER OF TOTAL AND INTERSTATE MOVES FOR TECHNICIANS BY TYPE OF TRAINING

Area Of Technical Specialization	$\bar{x}$ Total Moves				$\bar{x}$ Interstate Moves			
	High School	Post-High School	On-the-Job	Total	High School	Post-High School	On-the-Job	Total
Electronics	1.5	2.0	1.3	1.9	.5	1.0	.4	.9
"Other"	1.1	1.5	1.6	1.5	.4	.7	.5	.6

provide more meaningful generalizations, the rate of geographic mobility for respondents to the Eninger (1965) study was calculated (Eninger computed job related changes only). Taking the group in the Eninger study which had, at the time of the survey, been in the workforce for 10 years as a comparison group, the yearly rate of job related residence changes was found to be .04 (.4÷10). (See Eninger, 1965, page 12-8.) Assuming that this yearly rate of residence change would not increase, it was estimated that over a 15-year period--the approximate work period of the average respondent in the current study--the average subject in the Eninger study would have experienced .6 job related residence changes (.04x15).

When this rate of residence change (.6) is compared to the data in Table 8, page 87, it can be seen that electronic technicians, (with a residence change rate of 1.9), taken as a group, had experienced residence changes at a rate three times greater than that of the Eninger group. For "other" technicians (with a residence change rate of 1.5), this rate was 2.5 times greater.

In order to compare another group to the respondents in this study, the mobility patterns reported by Marsh (1967) for a cross section of the United States population were examined (Table 9, page 90). In this study, the degree of geographic mobility was computed in terms of the percentage of population which moved during 1 year, 5 years, 12-13 years, and "lifetime" periods.

The comparison showed that the respondents in the current study classified as electronic technicians, and having a mean age of 33.8, had exceeded the "lifetime" mobility rate established in the Marsh study. Seventy-two percent of the electronic technicians had experienced one or more moves since completion of their training, while only 68 percent of those surveyed by Marsh had moved since birth. The number of "other" technicians who had moved one or more times since the completion of training represented 63 percent of the total group. The higher rate for subjects in the current study was manifest despite the fact that mobility patterns for technicians in this study were assessed only from the time they began work to the time of the study. Thus 20 years of prework mobility was unassessed.

In referring to Table 9, the reader will note that seven studies were analyzed in order to provide

TABLE 9

COMPARISON OF STUDIES WHICH HAVE CALCULATED GEOGRAPHIC MOBILITY OF SUBJECTS AS PERCENTAGE WHO MOVED

Studies	Percentage of Sample That Moved	Time Period In Which Percentage Was Calculated
Coe and Zanzalari, (1965, p. 24)	14	10 Years
Eninger, (1965, p. 2)	17	11 Years
	3	1 Year
Saben, (1964, p. 397)		
Unemployed Workers	11	1 Year
Employed	6	1 Year
United States Department of Labor, (1967, pp. 5-6)	40	5 Years
Blau and Dongan, (1968, p. 225)	60	Since Birth
Marsh, (1967, p. 15)	5	1 Year
	15	5 Years
	29	12-13 Years
	68	Since Birth
Kobus, (1967, p. 7)	10	While Employed at NASA
Current Study		
Electronic Technician	72	Since Training[a]
"Other" Technicians	63	Since Training[a]

Note:

[a] The mean number of years since training was completed was estimated as 14 years for Electronic Technicians and 16 years for "Other" Technicians.

a greater comparison than would otherwise be possible. The difficulty in finding a common denominator, in order to achieve a meaningful comparison, is obvious. However, if one takes the number of years the average technician has spent in the workforce--14 years for post-high school trained electronic technicians and 16 years for "other" technicians--and uses this as an estimator, he will see that a greater percentage of technicians in the current study moved than that of any other group.

Summary of Section I

In summarizing the findings of the geographic mobility behavior of the technicians in this study, it can be seen that significant differential mobility, across training environment, was not found. This would imply that the factors which cause, retard, or enhance geographic mobility were operating to nearly the same degree among technicians trained in high school, post-high school, or on-the-job. Furthermore, within each of these groups existed approximately the same percentage of non-movers, moderate movers, and extensive movers.

However, the technicians in this study taken as one group, did have a higher rate of geographic mobility than did the other comparison groups. The extent to which this higher rate of geographic mobility can be generalized to larger populations of technically trained manpower will determine the strength of this study as it relates, in contradistinction, to the studies of Eninger, Coe and Zanzalari, and Matteson.

It would appear that differential mobility may be more a function of the individuals occupational classification than it is of the environment in which training is received. An appropriate topic for further study might well be the assessment of the degree to which differential mobility is a function of occupational classification.

If one determines that the geographic mobility findings of this study can be generalized to represent the total population of technicians, then one must question a basic tenet in technical training. This tenet purports that technical training should be designed exclusively in terms of local manpower needs. With about 75 percent of the technicians in this study having changed their residences one or more times, it is questionable whether it is appropriate for vocational educators to continue to place their faith in this time-honored tenet.

For the educational practitioner, in this case the individual responsible for the development of classroom experiences for technicians-in-training, this assessment of geographic mobility should signal the need for curriculum re-evaluation. The extent to which a particular course is built solely in terms of the esoteric requirements of a local industry may well be the measure of its irrelevance to the employment needs--present and future--of the majority of students it purports to train.

It does not logically follow, however, that technical training should be oblivious to the needs of local industries; for approximately one-third of the group receiving training will become local manpower. What is needed then, are predictive curricular experiences which will enlarge the individual's "market place" without restricting his "saleability" within the local employment market.

Section II - Occupational Mobility

The reader will recall that the term "occupational mobility" was operationally defined, for the purposes of this study, as: a product value derived as the result of multiplying the total number of job changes experienced since the completion of technical training minus one, by the sum of the values--skill/knowledge and product/service--assigned to these changes. That is:

$$M_o = (N-1) \sum (S+P)$$

where M_o = Occupational Mobility

N = Number of jobs held since the completion of technical training.

S = Assigned value for the degree of skill and knowledge change.

P = Assigned value for the degree of product and service change.

The resulting values of this manipulation were compared in the statistical analysis reported in Table 5, page 73.

The findings in this study led to the following conclusions regarding occupational mobility:

Conclusion 7. Differential occupational mobility was not significantly related (at the .05 level) to the learning environment in which technicians--electronic and "other"--received their training.

Conclusion 8. The occupational mobility behavior of different groups of technicians was consistent, whether the measure used was number of technical jobs, number of nontechnical jobs, assigned skill/knowledge value, or assigned product/service value.

Conclusion 9. The occupational mobility behavior of the technicians in this study was found to be consistent with the findings of other comparable studies.

Conclusion 10. During their work histories, a significant percentage of technicians changed jobs.

Conclusion 11. Approximately two-thirds of the technicians studied changed jobs after completion of technical training. Of this number, nearly one-third moved three or more times.

Conclusion 12. On the average, the technicians in this study held three jobs during their work histories.

Conclusion 13. One out of every three jobs held during the work histories of the technicians was with a different employer.

Conclusion 14. Although technicians changed jobs and employers, these changes occurred within their specific areas of specialization.

Conclusion 15. When technicians changed jobs they were apt to encounter different products and/or services, which normally required them to apply different skills and knowledge.

Conclusion 16. While technicians were required to use the theory of their technology "most of the time," they employed the tools and equipment associated with their area of specialization about "half of the time."

Conclusion 17. Technicians were supervised by engineers and scientists about "half of the time," while they, in turn, supervised other technical personnel also, approximately, "half of the time."

When analyzing Table 5, page 73, it can be seen that, in addition to finding a similarity in occupational mobility behavior among types of training, the same similarity was found between groups of technicians. This similarity in behavior between the two groups was consistent with the data previously reported in Table 2, page 57, Table 3, page 59, and Table 4, page 70. However, two questions arose: Did the similarity in the means, between electronic technicians and "other" technicians, and among types of training, represent a real indication of homogeneity? Or did the fact that the occupational mobility index was a product of a number of variables, $M_o = (N-1) \sum$ (S+P), mask real differences?

To answer these questions, the raw data were analyzed. It can be seen (Tables 10 and 11, pages 98 and 100, respectively) that the factors affecting occupational mobility--number of technical jobs, number of nontechnical jobs, skill/knowledge value, and product/service value when examined separately showed the same degree of homogeneity as did the occupational mobility means.

By referring to Table 10, page 98, the reader can see that the number of technical jobs, with all types of training taken together, for electronic technicians was 2.7, while this mean for "other" technicians was 2.8. This reveals a distinct similarity on the first variable. An examination of the second variable--mean number of nontechnical jobs--also revealed a similar consistency--.09 for electronic technicians and .15 for "others." When the remaining variables--skill/knowledge value and product/service value--were examined, (Table 11, page 100), the similarity between groups again was found to be consistent, a 2.8 skill/knowledge value for electronic technicians against a 2.7 skill/knowledge index for

TABLE 10

MEAN NUMBER OF TECHNICAL AND NONTECHNICAL JOBS SINCE COMPLETION OF TRAINING, REPORTED BY TYPE OF TRAINING

Area of Technical Specialization	$\bar{x}$ Number of Technical Jobs							
	High School		Post-High School		On-the-Job		All Types of Training	
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
Electronics	2.9	14	2.6	115	2.9	14	2.7	143
"Other"	3.2	51	2.8	377	2.8	97	2.8	525

TABLE 10--Continued

$\bar{x}$ Number of Nontechnical Jobs							
High School		Post-High School		On-the-Job		All Types of Training	
$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
.02	14	.11	115	.03	14	.09	143
.02	51	.13	377	.30	97	.15	525

TABLE 11

MEAN ASSIGNED SKILL/KNOWLEDGE VALUE AND PRODUCT/SERVICE VALUE BY AREA OF SPECIALIZATION

Area of Technical Specialization	$\bar{x}$ Assigned Skill/Knowledge Value	$\bar{x}$ Assigned Product/Service Value
Electronics	2.8	1.5
"Other"	2.7	1.7

"other" technicians. The same degree of homogeneity was found among the two groups--electronic and "other"--with the product/service index: 1.5 and 1.7, respectively.

The determination of the skill/knowledge and product/service value represents an attempt to equate the severity of a particular job change on two dimensions. First, the subject was asked to provide an assessment of the degree that a particular job change required him to apply new or different skills and/or knowledge. And second, the subject was asked if this change involved working with new products or services, (See Questions 31-34 of the Questionnaire, page 165). Basically, this assessment revealed that electronic and "other" technicians, upon changing jobs--the mean number of jobs held for both groups of technicians was approximately three (Table 12, page 102)--perceived these changes to require from "somewhat" to "considerable" application of different skills and knowledge. Nearly the same degree of severity of job change was perceived when the technicians rated a particular job change according to different products and/or services. Ratings of this variable indicated again, that the technicians experienced between "somewhat" and "considerable" different products and/or services when they

TABLE 12

MEAN NUMBER OF JOBS AND EMPLOYERS SINCE COMPLETION OF TECHNICAL TRAINING BY TYPE OF TRAINING

Area of Technical Specialization	$\bar{x}$ Number of Jobs							
	High School		Post-High School		On the-Job		All Types of Training	
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
Electronics	2.9	14	2.7	115	3.1	14	2.8	143
"Other"	3.4	51	2.9	377	3.1	97	3.0	525

TABLE 12--Continued

$\bar{x}$ Number of Employers							
High School		Post-High School		On the-Job		All Types of Training	
$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
2.1	14	2.2	115	1.7	14	2.1	143
2.3	51	2.3	377	1.9	97	2.2	525

changed jobs. Again, it must be pointed out that this finding should be interpreted in light of the fact that, by and large, the technicians in this study did not leave the area of specialization for which they were trained and return. This study did not examine the degree of "out migration" within a particular area of specialization since the only subjects examined were currently employed in the area for which they were trained.

In summarizing the results to which a change in job involved different skills, knowledge, products, or services, it can be said that technicians, when changing jobs, are apt to encounter different products and/or services to which they need to apply different skills and knowledge.

Number of Jobs Versus Number of Employers

The subjects in this study reported that while they had experienced, on the average, three jobs since completion of training; they had worked for two different employers. In other words, the employment history of technicians indicates that, on the average, technicians tend to remain with the same employer through only one job change. The data from which these conclusions were drawn is shown in Table 12, page 102. Here it can be seen that for both groups of technicians, and across all types of training, the number of jobs held since completion of training "rounded off" to three, while the number of employers "rounded off" to two.

Percentage Changing Jobs

Table 13, page 106, categorizes the number of technicians experiencing "0 changes," "1-2 changes," and "3 or more changes." It was found that approximately 71 percent of electronic technicians experienced one or more job changes since they completed their training. At the same time, 75 percent of "other" technicians were so classified.

The results in Table 13 provides for an interesting comparison between the percentage of technicians who change jobs and the percentage who change residence, see Table 14, page 107. The percentages are very similar between those classified as non-movers, in terms of residence changes, and those who did not experience any job changes. The percentages of electronic technicians who had no residence changes and no job changes were 28 and 29 percent, respectively. This same comparison showed that 37 percent of "other"

TABLE 13

MEAN NUMBER OF JOB CHANGES EXPERIENCED BY TECHNICIANS SINCE COMPLETION OF TECHNICAL TRAINING

Area of Technical Specialization	0 Changes		1-2 Changes		3 or More Changes	
	N	%	N	%	N	%
Electronics	41	29	59	41	43	30
"Other"	133	25	199	38	193	37

TABLE 14

THE NUMBER OF INTERCITY MOVES OF TECHNICIANS TRAINED IN POST-HIGH SCHOOL COMPARED TO THE NUMBER OF INTERCITY MOVES OF TECHNICIANS TRAINED OUTSIDE THE POST-HIGH SCHOOL

Area of Technical Specialization	Trained in Post-High School					
	0 Moves		1-2 Moves		3+ Moves	
	N	%	N	%	N	%
Electronics	29	25	49	43	37	32
"Other"	135	36	161	43	81	22

TABLE 14--Continued

Trained in High School and On-the-Job						Total All Training					
0 Moves		1-2 Moves		3+ Moves		0 Moves		1-2 Moves		3+ Moves	
N	%	N	%	N	%	N	%	N	%	N	%
11	39	10	36	7	25	40	28	59	41	44	31
59	40	59	40	30	20	195	37	220	42	110	21

technicians experienced no residence change, while 25 percent had not changed jobs.

When the geographic mobility index of a respondent was compared to his occupational mobility index the product moment correlation coefficient was found to be no more than .20 (Table 6, page 75). This implies that there was little linear relationship between an individual's geographic mobility and his occupational mobility.

However, a comparison, (chi-square), of technicians experiencing varying rates of residence and job changes showed a significant relationship (P .001) between these two variables ($x^2 = 35.72$).

From this chi-square analysis one can conclude that, the number of residence changes and the number of job changes are not independent. The failure to obtain a significant correlation, using the Pearson Product-Moment statistic, between the two variables is perhaps based upon the fact that their relationship, while significant is non-linear.

Occupational Mobility Comparisons

Table 15, page 110, represents an attempt to compare the occupational mobility behavior of the technicians in this study to the occupational mobility

TABLE 15

COMPARISON OF STUDIES WHICH HAVE CALCULATED OCCUPATIONAL MOBILITY OF SUBJECTS AS PERCENTAGE WHO MOVED, AND/OR MEAN NUMBER OF JOBS HELD

Studies	Percentage of Sample Which Changed Jobs	Time Period Over Which Mobility Was Calculated	Mean Number of Jobs Held by Sample
United States Department of Labor, (1954, p. 29)		12 Years	3.0
Saben, (1967, p. 31)	7.8	1 Year	
Perrella & Waldman, (1966, p. 863)	50	1 Year	
Eninger, (1965, p. 34)		10 Years	3.1
		5 Years	2.5
		1 Year	2.0
Cox & Sanselari, (1965, p. 12)		10 Years	2.3
Current Study			
Electronic Technician	71	Since Training	2.8[a]
"Other" Technician	75	Since Training	3.0[a]

Note:

[a] The Mean Number of years since training was completed was estimated as 14 years for Electronic Technicians and 16 years for "Other" Technicians.

behavior found in other studies. The difficulty in finding a common denominator for all comparisons was, again, obvious. However, by making the same kinds of assumptions made for Table 9, page 90, a qualified comparison could be made. The most appropriate comparison was made in regard to the mean number of jobs held. Here it can be seen that the studies of the United States Department of Labor (1954), Eninger (1965), and Coe and Zanzalari (1965) had findings quite similar to those of the current study.

The United States Department of Labor study found its subjects holding, over a 12-year period, 3.0 jobs. Eninger's mean for 1953 graduates was 3.1 jobs. The Coe and Zanzalari study had the smallest mean: 2.3 jobs being reported by the respondents 10 years after graduation. The mean numbers of jobs held by the respondents in these studies compare very closely with the mean of 2.8 jobs reported by electronic technicians and the mean of 3.0 jobs reported by "other" technicians.

The reader is again reminded of the differences in interpretation placed upon these very similar findings by various researchers.

The United States Department of Labor (1970, p. 13) researchers interpreted their mobility findings (3.8 jobs over 12 years) as representative of "a group who are above average in their propensity to change jobs." Contrasted to this is the interpretation Eninger placed on finding his subjects had held a mean of 3.1 jobs over 10 years: "Vocational graduates do not do much moving from employer to employer [p. 34]." These contradictions must be taken into consideration by those who would interpret and use the findings in the study reported here. These differences in opinion point out, again, the relativity of the importance attached to mobility findings.

Employment Tasks

In order to determine the current employment tasks of the subjects in this study, a measure was devised to examine the amount of time a technician spent in: (1) applying the theory of his technology, (2) employing the tools and equipment associated with his technology, (3) supervising the activities of other technical personnel, and (4) working under the direct supervision of graduate engineers or scientists (See Questions 35-38 in the Questionnaire, page [illegible]). The results of this assessment can be found in Table 16, page 114.

In summary, the technicians, taken together as one group, employ the theory associated with their technology "most of the time," while using the hand tools and equipment about "half of the time." The degree to which they supervise other technical personnel was reported as "half of the time." They also felt they spent about "half of the time" on their current job working under the direct supervision of graduate engineers or scientists. The findings of this employment task assessment could be generalized across types of training and areas of specialization because of the similarities of the various means.

The implications of these results, although not bearing directly upon the hypotheses tested, should have significance for curriculum development. The knowledge, for example, that the theory underlying a particular area of specialization is employed "most of the time" suggests that a reasonable facility with the theory should be a terminal objective in a technology program. Although this study did not assess, in any depth, the type, extent, or degree of the theory being employed, it did determine the perceptions a technician

TABLE 16

MEAN CURRENT EMPLOYMENT TASK INDEX BY TYPE OF TRAINING

Area of Technical Specialization	$\bar{x}$ Theory Index							
	High School		Post-High School		On-the-Job		Total	
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
Electronics	3.0	14	2.7	115	2.6	14	2.7	143
"Other"	2.7	51	2.6	377	2.8	97	2.6	525

Area of Technical Specialization	$\bar{x}$ Supervisor Index							
	High School		Post-High School		On-the-Job		Total	
	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
Electronics	3.6	14	1.9	115	2.3	14	2.1	143
"Other"	2.3	51	2.1	377	2.3	97	2.2	525

Note:

4 = All of the Time
3 = Most of the Time
2 = Half of the Time
1 = Very Seldom
0 = Never

TABLE 16--Continued

$\bar{x}$ Equipment Index							
High School		Post-High School		On-the-Job		Total	
$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
2.5	14	2.3	115	2.4	14	2.3	143
2.4	51	2.4	377	2.5	97	2.4	525

$\bar{x}$ Supervised Index							
High School		Post-High School		On-the-Job		Total	
$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=	$\bar{x}$	N=
2.0	14	1.8	115	2.0	14	1.8	143
2.4	51	2.2	377	2.1	97	2.2	525

had relative to the extent to which he used the theory associated with his specialization. Finding this perception to be constant among technicians from different types of training environments and different areas of specialization seemed to indicate the reliability of this assessment.

A major consideration in technical curriculum development has always been the determination of proper proportion between the student's time spent in developing a theoretical background in relation to the time devoted to developing skills in the use of the tools and equipment of his "trade." These are often competing objectives and, therefore, judgments must be made between them. In the absence of hard data, most curriculum developers make judgments in terms of their own experiences. This can be valid, assuming, of course, the individual developing a particular curriculum had the appropriate experience. However, when the question of appropriating limited resources (money and space) must be resolved, then hard data, which refers directly to the time and extent to which tool and equipment skills are actually employed, is an absolute necessity. The assessment of the respondents in this study, in this regard, is, by design, gross. However, it does provide some insights which may be of help to those making curriculum decisions.

The next two assessments were devised to measure the extent to which the electronic technician worked with people. Too often the curriculum in both the high school and the post-high school fails to consider the need its students have for developing skills which will improve their ability to interact with people. The present findings would imply that the average technician is, about "half of the time," supervising and being supervised. To a curriculum developer this should signal the need for a student to have relevant experiences in order to improve his communication (verbal and nonverbal) skills. In addition, the need for learning experiences which would develop an individual's ability to relate with people would also seem to be of major importance. Perhaps the most important contribution these two measures can make is dispelling the notion that technicians are insulated from people and need only be provided learning experiences which equip them to relate to things.

Summary of Section II

Possibly the easiest and most direct way to summarize and interpret the occupational mobility behavior of the subjects taking part in this study would be to classify their behavior as consistent. They were consistent in that their behavior was similar across types of training, between areas of specialization, and with the findings from other studies.

This degree of internal and external consistency allows one to be more comfortable when generalizing the findings reported here. The findings of this study indicate that technicians are not apt to remain in their first job or with the same employer. For those who do change jobs, new and different products were usually encountered, and they were required to apply different skills and knowledge.

However, the reported occupational mobility was almost always within the area of the individual's specialization. When these occupational mobility findings are coupled with the results of the current employment task analysis, the technicians in this study could be described as performing in the following ways, they: (1) remain in their area of specialization, (2) move among jobs and employers, (3) encounter different products, (4) are required to apply a variety of skills and knowledge, and (5) are theory oriented because of job demands. However, they continue to utilize the tools and equipment of their technology. And, in addition, they occupy a position somewhere between the craftsman and the engineer which requires them to interact with people as well as to work with things.

In light of these findings, it would appear that one could gauge the relevance of a particular technology program by assessing the degree to which the learning experiences enabled the student to perform in the manner described above. This performance could be quantified and, thus, provide a realistic evaluation of training.

Section III - Demographic Data

The data discussed here will supplement the discussion which took place in Chapter III under the heading of Subjects (Pages 52-61). Primarily, this section will concern itself with an examination of the technician in terms of the state where he received his training versus the state where he was employed at the time of the study. In addition, this section will discuss the relationship between mobility and other characteristics.

Conclusion 18. On the average, the subjects in this study were men (35 years of age), experienced in their technology (15 years), who had been trained in the post-high school.

Conclusion 19. The majority of the technicians employed in a given state were trained in that state.

Conclusion 20. Of the three states surveyed, New Jersey had the highest percentage of technicians "trained out of state."

Conclusion 21. Of the technicians employed in a state who were classified as "trained out of state," a significant number received their training in contiguous states.

Conclusion 22. The occupational mobility index was found to have a marked relationship to the number of technical jobs held (.72) and the total number of jobs held (.76).

Conclusion 23. The relationship between the number of technical jobs held and the total number of jobs held was found to be highly dependable (.94).

State Employed Compared to State Trained

Table 17, page 121, illustrates the comparison which can be made between the number of technicians employed in the states of New Jersey (N=84), New York (N=275), and Pennsylvania (N=309), and the states in which these technicians were trained.

It can be seen in the data that a considerable number of technicians working in a state were trained in that state. The comparison, however, shows that, of

TABLE 17

COMPARISON BETWEEN STATE WHERE EMPLOYED AND STATE WHERE TRAINED

States in Which Training Was Received	New Jersey			New York		
	Electronic Technicians	"Other" Technicians	Total Technicians	Electronic Technicians	"Other" Technicians	Total Technicians
	N=17	N=67	N=84	N=55	N=220	N=275
New Jersey	6	39	45	4	2	6
New York	4	5	9	40	190	230
Pennsylvania	2	13	15	3	11	14
Massachusetts	0	1	1	0	1	1
Vermont	0	0	0	0	1	1
Illinois	0	0	0	0	1	1
Delaware	0	0	0	0	1	1
South Carolina	0	0	0	0	0	0
Connecticut	0	2	2	0	0	0
Wisconsin	1	0	1	2	0	2
Ohio	0	0	0	0	2	2
New Hampshire	0	0	0	0	0	0
Michigan	0	0	0	0	0	0
Indiana	0	0	0	0	1	1
Florida	1	0	1	1	1	2
California	0	0	0	0	0	0
Texas	0	1	1	0	0	0
Kentucky	0	0	0	0	1	1
Georgia	0	1	1	0	0	0
Service	3	2	5	4	4	8
Out of Country	0	3	3	1	4	5
Total	17	67	84	55	220	275
Percent	2.5	10.0	12.6	8.2	33.0	41.1

TABLE 17--Continued

Pennsylvania			Total Technicians Trained by States	
Electronic Technicians	"Other" Technicians	Total Technicians		
N=71	N=238	N=309	N=	%
1	2	3	54	8.1
1	5	6	245	36.6
61	209	270	299	44.8
1	1	2	4	0.6
0	0	0	1	0.1
3	4	7	8	1.2
0	1	1	2	0.3
0	1	1	1	0.1
1	1	2	4	0.6
1	0	1	4	0.6
1	1	2	4	0.6
0	2	2	2	0.3
0	1	1	1	0.1
0	0	0	1	0.1
0	0	0	3	0.5
0	1	1	1	0.1
0	0	0	1	0.1
0	0	0	1	0.1
0	0	0	1	0.1
1	9	10	23	3.4
0	0	0	8	1.2
71	238	309	668	100
10.6	35.6	46.3	100.0	

the three states surveyed, the technicians working in Pennsylvania and New York had a greater percentage of their group "home grown." Pennsylvania had trained 87 percent of the technicians it was employing while New York had trained 84 percent. New Jersey, low in comparison, had only trained 54 percent of its technicians. To determine the cause of this inconsistency, between the state of New Jersey and the states of New York and Pennsylvania, was outside the scope of this study.

Looking at Table 17, page 121, in another way, it can be seen that nearly as many technicians migrate into New Jersey for jobs as are trained there. Furthermore, those who do migrate into the state for jobs are more apt to come from the contiguous states of Pennsylvania and New York than from any other states. This is not the case for Pennsylvania and New York. In these states, most of the technicians employed in the state were trained in the state and, furthermore, the contiguous states, taken together, do not supply more technical manpower than that which comes from other states and other sources, i.e., service trained and out-of-the-country trained.

When these training and employment data were examined it was found that the states in the Middle

Atlantic State Region trained about 90 percent of the technical workforce surveyed and import the remaining 10 percent. No comparable figures were available on the export ratio of this Region.

Correlations

Table 6, page 75, represents an attempt to determine if two kinds of mobility, geographic and occupational, were related to other factors which could be gleaned from the data. It can be seen from the table that, with the exception of the .72 correlation coefficient found between occupational mobility and the number of technical jobs; the .76 coefficient found between occupational mobility and total number of jobs; the .78 between geographic mobility and number of intercity moves; and, the .86 found between geographic mobility and assigned distance value; no significant linear relationships could be identified between the remaining variables. Finding a significant correlation between the geographic mobility index, number of intercity moves, and assigned distance value is understandable since each was a component in calculating the index. The same is true for the relationship found between the occupational mobility index, number of technical jobs, and total number of jobs. However, the reason for making these comparisons was to test the need for using a formula in assessing mobility as opposed to counting just residence changes and job changes. It would appear that the mere counting of changes would suffice.

The lack of significant linear relationships between some of the other variables is also understandable. For example, the fact that no significant relationship could be found between age and mobility was not surprising since mobility was computed over the entire work history of the subject. If age had been held constant, and mobility were examined for the previous years, then a high correlation would have been expected. However, a reasonable explanation for not having found a high correlation between mobility and years of education is more difficult to provide. Possibly the large percentage of subjects who had had post-high school training (75 percent) accounted, at least in part, for this lack of relationship.

Summary of Section III

After summarizing the findings of this section, it seems apparent that the subjects examined in this study reflected what might be termed a very "healthy technical manpower posture." They were, in most cases, post-high school trained, having both youth and experience. These factors reflect the viable nature of this segment of the workforce. One could develop, from this assessment, a very positive prognosis for future technical development.

The fact that nearly three-quarters of the technicians surveyed had been trained in the post-high school would seem to imply that, if technical jobs were to become highly competitive, a post-high school background might well become a condition of employment.

When one examined the extent to which the technicians employed in a state were trained in that state, support can be found for those who maintain that it makes good economic sense for a state to invest in training technical manpower. The sizable percentage of technicians employed in the states where they were trained speaks to this issue. However, there are many other variables which must be examined before this issue can be dealt with completely. The findings in this study merely point out that a sizable percentage of the technicians employed in the Middle Atlantic States Region were trained there, and now have become taxpayers in the states which subsidized their training.

Section IV - Training

In the following section the discussion will center around the training background of the technicians in this study.

Conclusion 24. Virtually all of the technicians studied had completed high school.

Conclusion 25. While in high school, a majority of the technicians were enrolled in the college curriculum.

Conclusion 26. While in high school, a majority of technicians demonstrated an ability in mathematics.

Conclusion 27. High school mathematics and post-high school engineering courses were rated as the most relevant subjects for the technician's current job.

Conclusion 28. Nearly half of all the technicians surveyed were continuing their technical training with 25 percent registered in degree programs.

Conclusion 29. The most common type of on-the-job technical training was informal, taking place at the "bench."

Conclusion 30. Technical Institutes and 2-Year Colleges were the most common types of post-high school environments in which technicians were trained.

Table 18, page 129, shows the number and percentage of technicians who were graduated from high school. In addition, it provides data on the type of curriculum studied by those completing high school. It can be seen that nearly all of the technicians in this study were high school graduates. Of those who were graduated, about 50 percent had studied the college curriculum. The remaining high school curricula in which the electronic technicians had been enrolled were, in decending order, the: (1) General curriculum (20.9 percent), (2) Vocational curriculum (17.3 percent), (3) Business curriculum (2.0 percent), (4) other curriculum (history, art, science) (2.9 percent), and (5) Industrial Arts curriculum (1.4 percent). For the "other" technicians, the order of the curricula studied were the: (1) College curriculum (49.3 percent), (2) General curriculum (27.1 percent), (3) Vocational curriculum (16.8 percent), (4) Industrial Arts curriculum (4.1 percent), (5) Business curriculum (1.4 percent), and (6) other curriculum (1.4 percent).

The data from this table shows that about half of all the technicians studied (slightly higher for electronic technicians) were enrolled in the high school College curriculum.

TABLE 18

TECHNICIAN'S HIGH SCHOOL CURRICULUM

Area of Technical Specialization	Curriculum Studied					
	Completed 12th Grade		College		General	
	f	%	f	%	f	%
Electronics	139	97.2	76	54.7	29	20.9
"Other"	513	97.7	253	49.3	139	27.1

TABLE 18--Continued

Business		Vocational		Industrial		Other	
f	%	f	%	f	%	f	%
4	2.9	24	17.3	2	1.4	4	2.9
7	1.4	86	16.8	21	4.1	7	1.4

Table 19, page 132, summarizes the high school subject the respondent rated as his highest achievement subject and compares this subject with the subject he identified as most important in regard to his current job (Questions 9 and 10 in the Questionnaire).

This comparison showed, among other things, that mathematics was considered by more than half of the technicians to be the most important high school subject for their current job responsibilities. Science and the other subjects identified occupied less important positions. Furthermore, a significant number of technicians rated mathematics as their "best" high school subject. It was also found that about 50 percent of the technicians rated the high school subject in which they received the best grades as the most important subject for their current job. This would seem to imply that half of the respondents perceived their best high school subject to have the most relevance for the job they were currently performing.

When this same assessment was made of technicians who had post-high school experience, Table 20, page 134, mathematics was rated as less relevant. In this assessment 62.1 percent of the electronic technicians rated their most important post-high school subject as

TABLE 19

RELATIONSHIP BETWEEN HIGH SCHOOL SUBJECTS RATED BY TECHNICIANS FOR HIGHEST ACHIEVEMENT AND FOR MOST IMPORTANCE FOR CURRENT JOB

Area of Technical Specialization	Highest Achievement Subjects					
	Mathematics		Science		English	
	f	%	f	%	f	%
Electronics	50	41.0	38	31.1	7	5.7
"Other"	213	46.4	70	15.3	42	9.2

Area of Technical Specialization	Most Important Subject					
	Mathematics		Science		English	
	f	%	f	%	f	%
Electronics	76	58.0	31	23.6	6	4.6
"Other"	316	64.4	50	10.2	31	6.3

TABLE 19--Continued

Social Studies		Industrial Arts		Business		Vocational	
f	%	f	%	f	%	f	%
9	7.4	6	4.9	0	0	12	9.8
41	8.9	64	13.9	2	.4	27	5.9

for Current Job

Social Studies		Industrial Arts		Business		Vocational		Agreement	
f	%	f	%	f	%	f	%	f	%
4	3.1	5	3.8	0	0	9	6.9	68	55.7
6	1.2	59	12.0	1	.2	28	5.7	275	59.9

TABLE 20

COMPARISON WITHIN AND BETWEEN POST-HIGH SCHOOL SUBJECTS RATED BY TECHNICIANS AS HIGHEST ACHIEVEMENT AND MOST IMPORTANT FOR CURRENT JOB

Area of Technical Specialization	Highest Achievement Subjects					
	Mathematics		Science		English	
	f	%	f	%	f	%
Electronics	33	34.7	7	7.4	1	1.1
"Other"	116	31.4	19	5.1	18	4.9

Area of Technical Specialization	Most Important Subject					
	Mathematics		Science		English	
	f	%	f	%	f	%
Electronics	23	24.2	8	8.4	5	5.3
"Other"	117	31.7	22	6.0	12	3.3

TABLE 20--Continued

Engineering		Social Studies		Business		Other	
f	%	f	%	f	%	f	%
51	53.7	0	0	0	0	3	3.2
197	53.2	3	.8	3	.8	14	3.8

for Current Job

Engineering		Social Studies		Business		Other		Agreement	
f	%	f	%	f	%	f	%	f	%
59	62.1	0	0	0	0	0	0	59	62.1
208	56.4	0	0	0	0	10	2.7	222	60.1

"engineering." The "other" technicians (56.4 percnet) did the same. In the agreement comparison, the percent of technicians who rated their best post-high school subject as also being the "most important" rose to about 60 percent.

An attempt was made in the survey to assess the extent to which technicians were continuing their training. Table 21, page 137, shows the results of this assessment. About 47 percent of electronic technicians and 40 percent of "other" technicians were enrolled in some form of formal program. Of those electronic technicians continuing their training, 5.9 percent were working on an Associate degree, 48.5 percent on a baccalaureate degree, and 45.6 percent on nondegree. The group of technicians classified as "other" report very similar percentages: 8.1 percent on an Associate degree, 45.2 percent on a baccalaureate degree, and 46.7 percent on nondegree.

The results of this examination of the data indicate that about 25 percent of the respondents currently employed as technicians were working toward professional classifications. Another 25 percent were continuing their training in a formal manner, but were doing so in nondegree granting programs. No assessment

TABLE 21

PERCENT OF TECHNICIANS CONTINUING THEIR TECHNICAL TRAINING BY TYPE OF DEGREE BEING SOUGHT

Area of Technical Specialization	Type of Degree Being Sought							
	Continuing Training		Associate		Bachelors		Nondegree	
	f	%	f	%	f	%	f	%
Electronics	68	47.6	4	5.9	33	48.5	31	45.6
"Other"	210	40.0	17	8.1	95	45.2	98	46.7

was made of the extent to which the remaining 50 percent of the technicians were engaged in informal technical training.

The results of the examination of the types of environment in which technicians were trained are shown in Tables 22, 23, and 24. In Table 22, page 139, it can be seen that technicians who identified their training environment as "high school" were apt to come with equal frequency from a vocational high school or a "regular" high school. This would seem to indicate that neither type of school has a monopoly on the production of technicians.

Table 23, page 140, summarized the type of on-the-job training program which accounted for the training of 9.8 percent of the electronic technicians and 18.5 percent of the "other" technicians. It can be seen that "informal" employer training programs, occurring at the "bench," were the most frequent form of on-the-job training. These accounted for 71.4 percent of the electronic technicians trained on-the-job and 61.0 percent of "other" technicians.

Table 24, page 141, shows that those classified as having been trained in post-high school were most often trained in either the Technical Institute or the

TABLE 22

TYPE OF HIGH SCHOOL IN WHICH TECHNICAL TRAINING WAS RECEIVED FOR TECHNICIANS IDENTIFIED AS HIGH SCHOOL TRAINED

Area of Technical Specialization	Vocational High School		Regular High School		Other		Total Trained in High School	
	f	%	f	%	f	%	f	%
Electronics	8	57.1	6	42.9	0	0	14	9.8
"Other"	30	58.8	21	41.2	0	0	51	9.7

TABLE 23

TYPE OF ON-THE-JOB EXPERIENCE IN WHICH TRAINING WAS RECEIVED FOR TECHNICIANS IDENTIFIED AS ON-THE-JOB TRAINED

Area of Technical Specialization	Formal Employer		Informal Employer		Apprentice Training		Manpower (MDTA)		Other		Total	
	f	%	f	%	f	%	f	%	f	%	f	%
Electronics	2	14.3	10	71.4	2	14.3	0	0	0	0	14	9.8
"Other"	15	15.5	59	61.8	20	20.6	1	1.0	2	2.1	97	18.5

TABLE 24

TYPE OF INSTITUTION IN WHICH TRAINING WAS RECEIVED

Area of Technical Specialization	Vocational Technical School Post Graduate		Technical Institute		2-Year College	
	f	%	f	%	f	%
Electronics	4	3.5	38	33.0	51	44.3
"Other"	5	1.3	119	31.6	174	46.2

TABLE 24--Continued

Science 4-Year College		Engineering 4-Year College		Armed Forces		Other		Total	
f	%	f	%	f	%	f	%	f	%
4	3.5	9	7.8	9	7.8	0	0	115	80.4
7	1.9	54	14.3	15	4.0	3	.8	377	71.8

2-Year College. Together, they accounted for the training of about 77 percent of the technicians.

It would seem from these data that the greatest contributor to the technical manpower pool of the states studied was the 2-year post-high school program in the Technical Institute and the 2-Year College; for these training environments produced more than two-thirds of the subjects of the current study.

Summary of Section IV

In summarizing the results of this section three major findings stand out. First, the post-high school environment was the most common training ground for technicians. Second, mathematics has assumed an unquestionable position as a "vocational" subject, along with, and second only to, the specific post-high school engineering subjects. Third, nearly two-thirds of all the technicians surveyed entered their technical training environment (on-the-job or post-high school) after completing a General or College high school curriculum.

These findings would seem to suggest that modifications in the course offerings of many high schools would be in order. There appears to be evidence to support the development of an additional "track" or curriculum. This new series of course offerings, which might be called the Technical curriculum, would enable the student from both the College curriculum and the General curriculum to select technically oriented courses appropriate to their capabilities. This type of hybrid curriculum would allow students a kind of prevocational exposure to the more general concepts underlying broad areas of technology, without causing them to leave the curriculum that best fits their capabilities.

Thus the high school would be providing experiences that could prove invaluable for the student who chooses to continue his technical training in a post-high school. In addition, the student would have experienced a kind of across-the-board exposure to the various technologies, thereby helping him to make a more realistic choice of the area in which he would like to specialize.

The data further suggest at least for the technicians studied here, that the high school is losing its position as a terminal institution for the training of technical manpower. It is moving from the position of prime trainer to intermediate trainer, and it must now begin to offer courses to fit this new role.

Section V - Implications of Findings

The following, and final, section of this chapter will attempt to pull together the major findings of this study, and summarize them in relation to the implications they have for the technical curriculum.

Mobility

Finding. It has been pointed out that the mobility behavior (geographic and occupational) of technicians is relatively consistent across training environments and among areas of specialization. This would imply that the factors which enhance or retard migration are operating, to about the same degree, among all types of technicians regardless of where they were trained.

Implication. Curriculum developers, at all levels, must develop training programs which will be broad enough to enhance the employment opportunities of the "movers" yet specific enough to provide sufficient training for the "stayers."

It should also be remembered that, in addition to meeting the needs of those who will be employed in the local industries, the curriculum developer should provide for the training needs of those technicians already employed in the area who may return to the educational environment for upgrading.

Thus, the results of this study point out the need for technical training program developers to drop the "either/or" posture: local needs or national needs. They must begin to accept the responsibility they have for providing both types of training.

Similarity Among Technicians

Finding. The data in this study have shown the striking similarities among technicians from different specializations. Regardless of the dimension compared, the results were nearly always the same.

Implication. One could expect the results of a study which examined one specific area of specialization to be highly generalizable to other areas. Of course, this would refer only to those characteristics which both groups had in common. This similarity in behavior would allow the findings from a narrow study, which looked at only one area of specialization, to be generalized with a greater degree of confidence to other areas of technology. The reverse would also be true: the findings from general studies, those which looked at all areas of specialization together, could be applied with a greater degree of confidence to specific technologies.

Finding. The interpretation placed upon mobility findings varied considerably in spite of the fact that many of the findings were very similar.

Implication. The implication to be drawn from this finding is that one must be very careful when interpreting the description given to the mobility findings reported. For example, although nearly every study examined had reported the same rate of job change, the assessment of this rate varied from "considerable mobility" to "negligible mobility." The same number of job changes is often interpreted differently by different investigators. This makes it essential that the individual interpreting the findings of a particular study do so in light of the data and not in terms of the relative importance attached to the data by the investigator. Furthermore, the mere counting of the frequency of job changes may be of little or no help to the technical program developer. For example, if an electronic technician performs the identical task for three or four different employers, his occupational mobility should be interpreted differently than that of a technician who experiences different products and services which require him to apply different skills and knowledge.

Finding. When technicians changed jobs (and they did so almost always within their areas of specialization) they usually encountered different products and/or services which required them to apply relatively different skills and knowledge.

Implication. The training environments in which the technical expertise is developed should take into account the fact that technicians change jobs, change employers, and must apply a variety of skills and knowledge to different products. The degree to which this transfer of training is achieved efficiently will be a function of the degree to which it was planned. To assume that transfer of training will be a natural outgrowth of a learning experience would be to disregard the findings of an impressive array of theoretical research.

Finding. The technicians reported that they were both being supervised and were supervising about half of the time.

Implication. This point has been discussed at some length in a previous section. However, it is an important enough finding to be re-examined here. The implication is quite obvious, technical curriculums must provide learning experiences which will assist the technician in maximizing his communication skills (verbal and nonverbal) and his interpersonal relationship skills. The data from this study pictures a technician who interacts with people as much as he interacts with things.

Finding. Post-secondary institutions involved in technical training are both terminal and intermediate trainers. They have replaced the high school as a terminal trained for the technologies. And, by virtue of the number of their graduates who are enrolled in formal programs leading to a professional degree, they are functioning as intermediate trainers as well.

Implication. The dual responsibility implicit in this finding is obvious. However, the means used to meet it may be much more obscure. The need to have the 2-year post-high school institution train technical manpower can be documented effectively by their burgeoning enrollments. This responsibility, providing for exit level training (at the end of one or two years), must not be neglected for what some would perceive as the more prestigious type of transfer training. Here again it must not be a case of "either/or." We have a need for both types of programs. In fact the data support the so-called "lattice" concept, wherein, the learner is able (and encouraged) to move, with considerable ease, into and out of the learning establishment.

He can exit the learning environment when he feels he has sufficient marketable skills, and enter again, without being penalized, when he feels he is is need of additional training. In a changing technology it would seem that this type of open training should be the rule and not the exception.

Recommendations

The following section has been developed in order to provide the reader with a summarization of the major recommendations which have grown out of this research.

1. Technical curricula must be developed to meet the training needs of the "stayers," "movers," and the "returners."

2. The striking similarity among technicians from different training environments and from different areas of specialization suggest the appropriateness of establishing a national system for the retrieval and dissemination of research findings as they relate specifically to the "technical" occupational classification.

3. Valid and reliable measures must be developed and employed for assessing the extent to which a technician's skills, developed during training, are required

to modify due to his mobility behavior.

4. Technicians must be provided, during their training period, the opportunity to become skillful at "transferring training."

5. Technical curricula must provide learning experiences which will enhance the development of interpersonal relationship skills.

6. Technical training at the post-high school must be comprehensive enough to provide for:

  A. Incoming high school students with no previous training.
  B. Incoming high school students with extensive high school training.
  C. Incoming students from industry who seek to update their skills and/or work toward a professional degree.
  D. Returning students.
  E. Students who are forced to leave before completing formal 2-year programs.
  F. Students seeking Associate degrees.
  G. Students planning to transfer to 4-year institutions.

Recommendations For Research

The following is a list of recommendations for further research which grew out of this study. Some of the items on this list were the result of having discovered, ex post facto, weak spots in the design of the research. Others are listed because they seemed to be a logical continuation of the research reported.

1. Determine the benefit cost ratio accruing to a state from its investment in post-secondary technical education.

2. Determine the benefit cost ratio accruing to an individual from his investment in post-secondary technical training.

3. Determine the extent to which the skill/knowledge value and the product/service value change over time, in the same job.

4. Determine the extent to which programs, developed in the light of the needs of local industry, actually impedes mobility.

5. Determine the type of interpersonal relationship skills which are most often required of technicians.

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APPENDIX A

ENDORSING AGENCIES
The Institute for the Certification
of Engineering Technicians
American Society of Agricultural Engineers
American Society of Tool and Manufacturing
Engineers
Instrument Society of America
National Aeronautice and Space Administration
Rutgers University-The State University
of New Jersey
State of New Jersey Department of Education
State of New Jersey Department of Labor
and Industry

Dear Certified Technician:

Your help is urgently needed.

The Institute for the Certification of Engineering Technicians has assisted me in choosing you as a representative of a national stratified sample of Certified Engineering Technicians to take part in a Rutgers University research project of major importance.

This project is aimed at assessing the natural mobility patterns of Certified Engineering Technicians. The purpose of this study will be two fold: (1) the degree of geographic and employer mobility which you have experienced will provide those responsible for designing technical training with an indication of the degree to which technicians sell their skills and knowledge on a local market, as opposed to a national market, and (2) your mobility history will provide associations and employers such as those endorsing this study, with an indication of the degree to which you can be expected, given the proper incentive, to change geographic area.

All that you need do to render this very worthwhile contribution to education and your association is complete the following questionnaire. Won't you please take fifteen minutes now and provide the information needed and return the form in today's mail?

Thank you for this very important contribution. You may be assured that after the data are transferred to computer cards, this questionnaire will be destroyed and your anonymity will be guaranteed.

Sincerely,

Charles H. Buzzell
Principal Investigator

QUESTIONNAIRE

Section I Biography

1. Sex M F 2. Present Age________

3. Are you a veteran? Yes No

4. When did you receive your present certification from the Institute for the Certification of Engineering Technicians? Month_______ Year______

5. What is your grade? Junior Engineering Technician Engineering Technician Senior Engineering Technician

6. What is your area of specialization?

____
(Example: Electronics, Drafting, Chemical, etc.)

Section II Changes in Residence

7. Directions: List in order, (most recent first) all of the cities in which you have lived from the time you completed high school to the present. Do not include your duty stations while a member of the Armed Forces. (Please print clearly.)

City or Town	County	State	Date		Distance from Last Address
			From	To	
				Present	Miles
					Miles
					Miles
					Miles
					Miles
					Miles
					Miles

If additional space is required, please provide an insert page.

Section III Education

8. High School(s) Attended:

Name of School	Dates When Enrolled From	Dates When Enrolled To	Highest Grade Completed	Curriculum (e.g. College Prep, General, Vocational)
1.				
2.				

9. While in high school, in which subjects did you receive the highest grade?

Subject	Grade

10. List in order of importance, the high school subjects you now feel were most important for your present employment tasks.

Subjects

11. Did you attend a school after high school (post-high school)? Yes No (If no, skip to question 15)

12. If you attended a post-high school(s), complete the following:

Name of School	Dates When Enrolled From	Dates When Enrolled To	Type of Institution (e.g. 4-Year College, 2-Year College, Tech. Institute, etc.	Highest Grade Completed	Type of Degree of Certificate Awarded	Curriculum Studied
1.						
2.						

13. If you attended a post-high school, in which subjects did you receive the highest grades?

Subject	Average

14. If you attended a post-high school, list in order of importance the subjects you now feel were most important for your present employment tasks.

Subject

15. Are you presently continuing your technical training in some form other than informal on-the-job training? Yes No (If no, skip to question 17)

16. If Yes, please identify the type of program in which you are presently enrolled.

A. Type of program ________________________________
B. Is this continuing education for a degree or certificate? Yes No
C. If Yes, what type of degree or certificate is being sought? ____________________________
D. When do you expect to complete this program? Month ______________ Year __________

Section IV Source of Technical Training

17. Did you receive your technical training, for the technology in which you are now employed, in high school? No Yes (If Yes, skip to Question 21)

18. If No, did you receive your technical training, for the technology in which you are now employed in a post-high school? (i.e., Technical Institute, 2-Year College, 4-Year College, Armed Forces Training School, etc.) No Yes (If Yes, skip to Question 22)

19. If No, did you receive your technical training, for the technology in which you are now employed on-the-job? (i.e., Apprentice Training, M.D.T.A., In-Plant Training, etc.) No Yes (If Yes, skip to Question 25)

20. If No, please explain how you received your technical training. ______________________________________
____

HIGH SCHOOL TECHNICAL TRAINING

21. If you answered Yes to Question 17, how would you describe the high school in which you received your technical training?

    A. Vocational High School
    B. Regular High School
    C. Other (Please specify) ______________________

POST-HIGH SCHOOL TECHNICAL TRAINING (Including Armed Forces Training)

22. If you answered Yes to Question 18, how would you describe the post-high school in which you received your technical training?

    A. Vocational-Technical School
    B. Technical Institute
    C. 2-Year College
    D. Science Program in a Four Year College or University
    E. Engineering Program in a Four Year College or University
    F. Armed Forces Training School
    G. Other (Please specify) ______________________

23. If you attended more than one type of post-high school, identify the type you feel made the most significant contribution to your technical skill training by circling the letter preceding it.

24. What were the actual number of months spent in obtaining the training you have identified above as most significant? (Do not count summer vacation time.) months __________

ON-THE-JOB TECHNICAL TRAINING

25. If you answered Yes to Question 19, how would you describe the type of on-the-job training?

A. Formal employer training program. (Including regular classtime scheduled away from the "bench.")
B. Informal training "at the bench."
C. Apprentice Training
D. Manpower Development Training Program (MDTA)
E. Other (Please specify) ____________________

26. If you received more than one type of on-the-job training, identify the type you feel made the most significant contribution to your technical skill training by circling the letter preceding it.

27. What were the actual number of months spent in obtaining the training you have identified above as most significant? months__________

28. How many hours per day were spent in this training program? hours__________

SECTION V Occupational History

Directions: The following questions are designed to assess the degree to which your employment, as a technician, has changed.

29. How many different full-time jobs have you had as a technician since you completed your technical training? __________

30. How many different full-time jobs have you had since you completed your technical training which would not be classified as technical jobs? __________

31. Please complete one section for every job (technical and non-technical) you have held since you completed your training as a technician. Start with your present job. If additional space is required please supply an insert page.

Present Job Title	Specific Type of Technical Work Performed	Name of Employer	Annual Salary	Date From	To
					Present

A. Are the skills and knowledge required of this job different from those required of your previous job?

0 No 2 Somewhat 4 Considerably 6 Completely

B. Are the products and/or services associated with this job different from those of your previous job?

0 No 1 Somewhat 2 Considerably 3 Completely

32.

Next Previous Job Title	Specify Type of Work Performed	Name of Employer	Annual Salary	Date From	To

A. Were the skills and knowledge required ot his job different from those required of the job you held before this one?

No 0 Somewhat 2 Considerably 4 Completely 6

B. Were the products and/or services associated with this job different from those of the job you held before this one?

No 0 Somewhat 1 Considerably 2 Completely 3

33.

Next Previous Job Title	Specify Type of Work Performed	Name of Employer	Annual Salary	Date From	To

A. Were the skills and knowledge required of this job different from those required of the job you held before this one?

No	Somewhat	Considerably	Completely
0	2	4	6

B. Were the products and/or services associated with this job different from those of the job you held before this one?

No	Somewhat	Considerably	Completely
0	1	2	3

34.

Next Previous Job Title	Specify Type of Work Performed	Name of Employer	Annual Salary	Date	
				From	To

A. Were the skills and knowledge required of this job different from those required of the job you held before this one?

No	Somewhat	Considerably	Completely
0	2	4	6

B. Were the products and/or services associated with this job different from those of the job you held before this one?

No	Somewhat	Considerably	Completely
0	1	2	3

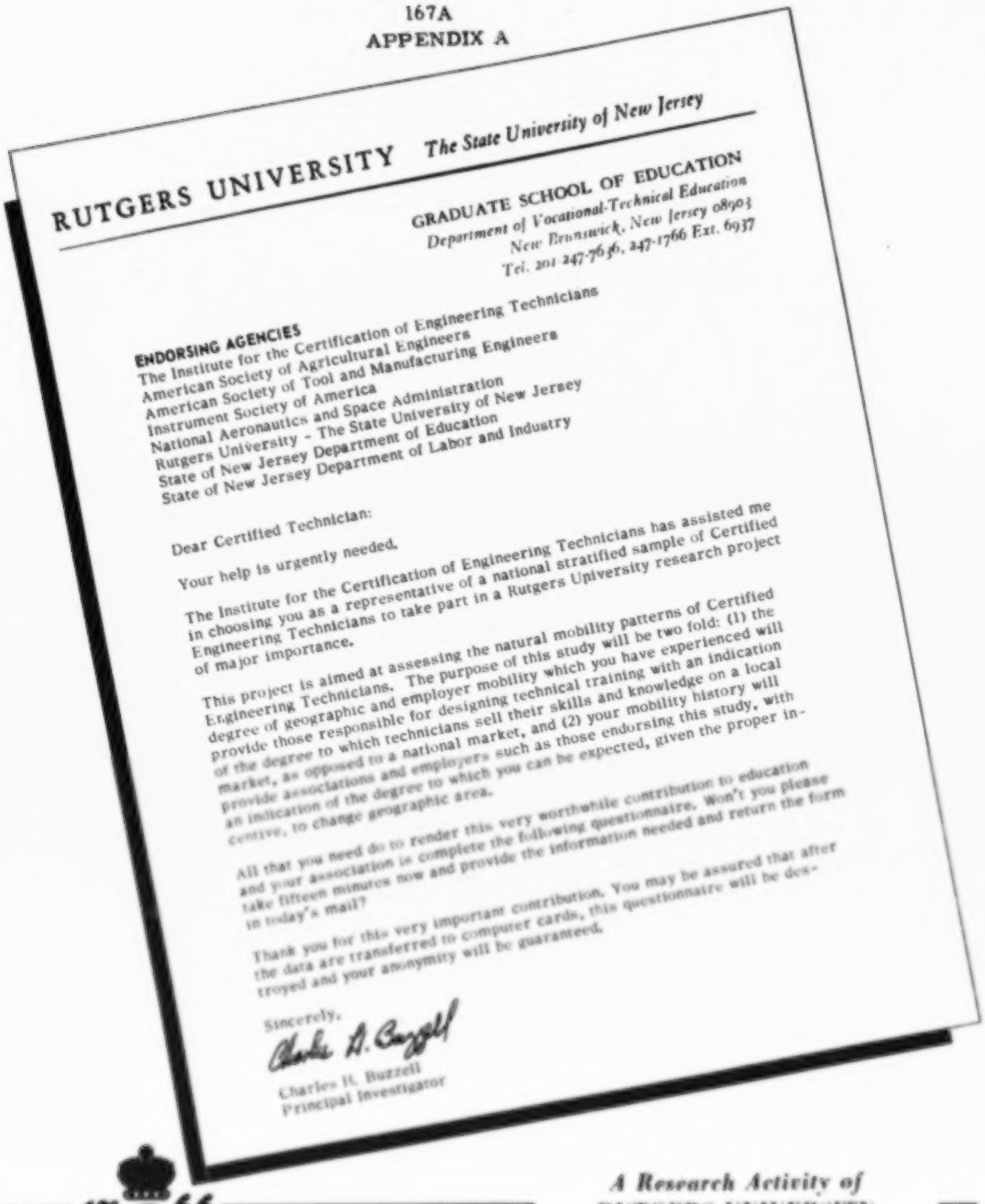
NOTE: If additional space is required for listing jobs, please provide an insert page. Thank you.

Section VI

Employment Task

	All of the time	Most of the time	Half of the time	Seldom	Never
35. How often does your present job require you to apply the theory of your technology (e.g., electron theory, mathematical concepts, physics, etc.)?					
36. How often does your present job require you to employ the hand tools and equipment associated with your technology (e.g., drafting tools, transit, test equipment, etc.)?					
37. How often does your present job require you to supervise the activities of other technical personnel?					
38. How often do you perform under the direct supervision of a graduate engineer or scientist?					
39. In the space below, please provide, in as much detail as is necessary, a job description of your present employment responsibilities.	4	3	2	1	0

APPENDIX A



RUTGERS UNIVERSITY *The State University of New Jersey*

GRADUATE SCHOOL OF EDUCATION
Department of Vocational-Technical Education
New Brunswick, New Jersey 08903
Tel. 201 247-7636, 247-1766 Ext. 6937

ENDORSING AGENCIES
The Institute for the Certification of Engineering Technicians
American Society of Agricultural Engineers
American Society of Tool and Manufacturing Engineers
Instrument Society of America
National Aeronautics and Space Administration
Rutgers University - The State University of New Jersey
State of New Jersey Department of Education
State of New Jersey Department of Labor and Industry

Dear Certified Technician:

Your help is urgently needed.

The Institute for the Certification of Engineering Technicians has assisted me in choosing you as a representative of a national stratified sample of Certified Engineering Technicians to take part in a Rutgers University research project of major importance.

This project is aimed at assessing the natural mobility patterns of Certified Engineering Technicians. The purpose of this study will be two fold: (1) the degree of geographic and employer mobility which you have experienced will provide those responsible for designing technical training with an indication of the degree to which technicians sell their skills and knowledge on a local market, as opposed to a national market, and (2) your mobility history will provide associations and employers such as those endorsing this study, with an indication of the degree to which you can be expected, given the proper incentive, to change geographic area.

All that you need do to render this very worthwhile contribution to education and your association is complete the following questionnaire. Won't you please take fifteen minutes now and provide the information needed and return the form in today's mail?

Thank you for this very important contribution. You may be assured that after the data are transferred to computer cards, this questionnaire will be destroyed and your anonymity will be guaranteed.

Sincerely,

Charles H. Buzzell

Charles H. Buzzell
Principal Investigator

1766

A Research Activity of
RUTGERS UNIVERSITY
The State University of New Jersey

167B

QUESTIONNAIRE

Section I

Biography

1. Sex ☐ M ☐ F 2. Present Age________ 3. Are you a veteran? ☐ Yes ☐ No

2. When did you receive your present certification from the Institute for the Certification of Engineering Technicians? Month________________ Year__________

5. What is your grade? Junior Engineering Technician ☐ Engineering Technician ☐ Senior Engineering Technician ☐

6. What is your area of specialization? ________________________________
(Example: Electronics, Drafting, Chemical, etc.)

Section II

Changes in Residence

7. Directions: List in order, (most recent first) *all* of the cities in which you have lived from the time you completed high school to the present. Do *not* include your duty stations while a member of the Armed Forces. (Please print clearly.)

City or Town	County	State	Date		Distance From Last Address
			From	To	
				Present	Miles
					Miles
					Miles
					Miles
					Miles
					Miles
					Miles

If additional space is required, please provide an insert page.

Section III

Education

8. High School(s) Attended:

Name of School	Dates When Enrolled		Highest Grade Completed	Curriculum Studied (e.g. College Prep, General, Vocational)
	From	To		
1.				
2.				

9. While in high school, in which subjects did you receive the highest grades?

Subject	Grade

10. List in order of importance, the high school subjects you now feel were most important for your present employment tasks.

Subjects

11. Did you attend a school after high school (post-high school)? ☐ Yes ☐ No (If no, skip to question 15)

12. If you attended a post-high school(s), complete the following:

Name of School	Dates When Enrolled		Type of Institution (e.g. 4-Year College, 2-Year College, Tech. Institute, etc.)	Highest Grade Completed	Type of Degree or Certificate Awarded	Curriculum Studied
	From	To				
1.						
2.						

13. If you attended a post-high school, in which subjects did you receive the highest grades?

Subject	Average

14. If you attended a post-high school, list in order of importance the subjects you now feel were most important for your present employment tasks.

Subjects

15. Are you presently continuing your technical training in some form other than informal on-the-job training?
☐ Yes ☐ No (If no, skip to Question 17)

16. If Yes, please identify the type of program in which you are presently enrolled.
A. Type of program. ____________________
B. Is this continuing education for a degree or certificate? ☐ Yes ☐ No
C. If Yes, what type of degree or certificate is being sought? ____________________
D. When do you expect to complete this program? Month ____________ Year ____________

Section IV **Source of Technical Training**

17. Did you receive your technical training, for the technology in which you are now employed, in *high school?*
☐ No ☐ Yes (If Yes, skip to Question 21)

18. If No, did you receive your technical training, for the technology in which you are now employed in a post-high school? (i.e., Technical Institute, 2-Year College, 4-Year College, Armed Forces Training School, etc.) ☐ No ☐ Yes (If Yes, skip to Question 22)

19. If No, did you receive your technical training, for the technology in which you are now employed on-the-job? (i.e., Apprentice Training, M.D.T.A., In-Plant Training, etc.) ☐ No ☐ Yes (If Yes, skip to Question 25)

20. If No, please explain how you received your technical training. ____________________

____

HIGH SCHOOL TECHNICAL TRAINING

21. If you answered Yes to Question 17, how would you describe the high school in which you received your technical training?
A. Vocational High School ☐
B. Regular High School ☐
C. Other (Please specify) ____________________

POST-HIGH SCHOOL TECHNICAL TRAINING (Including Armed Forces Training)

22. If you answered Yes to Question 18, how would you describe the post-high school in which you received your technical training?
A. Vocational-Technical School ☐
B. Technical Institute ☐

Cont. on opposite page.

C. 2-Year College ☐
D. Science Program in a Four Year College or University ☐
E. Engineering Program in a Four Year College or University ☐
F. Armed Forces Training School ☐
G. Other (Please specify) ____________________

23. If you attended more than one type of post-high school, identify the type you feel made the most significant contribution to your technical skill training by circling the letter preceding it.

24. What were the actual number of months spent in obtaining the training you have identified above as most significant? (Do not count summer vacation time.) months ____________

ON-THE-JOB TECHNICAL TRAINING

25. If you answered Yes to Question 19, how would you describe the type of on-the-job training?
A. Formal employer training program. (Including regular classtime scheduled away from the "bench.") ☐
B. Informal training "at the bench." ☐
C. Apprentice Training ☐
D. Manpower Development Training Program (MDTA) ☐
E. Other (Please specify) ____________________

26. If you received more than one type of on-the-job training, identify the type you feel made the most significant contribution to your technical skill training by circling the letter preceding it.

27. What were the actual number of months spent in obtaining the training you have identified above as most significant? months ____________

28. How many hours per day were spent in this training program? hours ____________

Section V Occupational History

Directions: The following questions are designed to assess the degree to which your employment, as a technician, has changed.

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30. How many different full-time jobs have you had since you completed your technical training which would not be classified as technical jobs? ____________

31. Please complete one section for every job (technical and non-technical) you have held since you completed your training as a technician. Start with your present job. If additional space is required please supply an insert page.

Present Job Title	Specific Type of Technical Work Performed	Name of Employer	Annual Salary	Date	
				From	To
					Present

A. Are the skills and knowledge required of this job different from those required of your previous job?
☐ No 0
☐ Somewhat 2
☐ Considerably 4
☐ Completely 6

B. Are the products and/or services associated with this job different from those of your previous job?
☐ No 0
☐ Somewhat 1
☐ Considerably 2
☐ Completely 3

32.

Next Previous Job Title	Specific Type of Work Performed	Name of Employer	Annual Salary	Date	
				From	To

A. Were the skills and knowledge required of this job different from those required of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 2 4 6

B. Were the products and/or services associated with this job different from those of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 1 2 3

33.

Next Previous Job Title	Specify Type of Work Performed	Name of Employer	Annual Salary	Date	
				From	To

A. Were the skills and knowledge required of this job different from those required of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 2 4 6

B. Were the products and or services associated with this job different from those of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 1 2 3

34.

Next Previous Job Title	Specify Type of Work Performed	Name of Employer	Annual Salary	Date	
				From	To

A. Were the skills and knowledge required of this job different from those required of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 2 4 6

B. Were the products and or services associated with this job different from those of the job you held before this one?

☐ No ☐ Somewhat ☐ Considerably ☐ Completely
0 1 2 3

NOTE: If additional space is required for listing jobs, please provide an insert page. Thank you.

Section VI **Employment Task**

	All of the time	Most of the time	Half of the time	Very Seldom	Never
35. How often does your present job require you to apply the theory of your technology (e.g., electron theory, mathematical concepts, physics, etc.)?					
36. How often does your present job require you to employ the hand tools and equipment associated with your technology (e.g., drafting tools, transit, test equipment, etc.)?					
37. How often does your present job require you to supervise the activities of other technical personnel?					
38. How often do you perform under the direct supervision of a graduate engineer or scientist?					
	4	3	2	1	0

39. In the space below, please provide, in as much detail as is necessary, a *job description* of your present employment responsibilities.

167F

Reseal For Mailing

Mr. Charles H. Buzzell
Department of Vocational-Technical Education
Graduate School of Education
Rutgers University
New Brunswick, New Jersey 08903

NOTICE

YOU HAVE BEEN SELECTED TO TAKE PART IN AN IMPORTANT RESEARCH PROJECT.

INSTITUTE FOR THE CERTIFICATION OF ENGINEERING TECHNICIANS

RUTGERS UNIVERSITY
The State University of New Jersey
Graduate School of Education
Department of Vocational-Technical Education
New Brunswick, New Jersey 08903

APPENDIX B

RESPONDENTS BY AREA OF TECHNOLOGY AND STATE

Area of Technology	New Jersey		New York		Pennsylvania		Total	
	n	%	n	%	n	%	n	%
Aerospace	0		0		4	.6	4	.6
Air Conditioning	0		2	.3	0		2	.3
Agriculture	0		1	.2	0		1	.2
Architecture	0		7	1.1	3	.5	10	1.5
Automotive	0		1	.2	0		1	.2
Chemical	4	.6	8	1.2	10	1.5	22	3.3
Civil	5	.8	51	7.6	30	4.5	86	12.9
Data Processing	0		0		1	.2	1	.2
Drafting	38	5.7	70	10.5	138	20.7	246	36.8
Electrical	4	.6	14	2.1	13	2.0	31	4.6
Electronics	17	2.5	55	8.2	71	10.6	143	21.4
Industrial	0		8	1.2	6	.9	14	2.1
Laboratory	0		4	.6	0		4	.6
Mechanical	15	2.2	53	7.9	28	4.2	96	14.4
Metallurgical	0		1	.2	2	.3	3	.5
Nuclear	0		0		1	.2	1	.2
Welding	1	.2	0		2	.3	3	.5
Totals	84	12.6	275	41.2	309	46.3	668	100.0*

Note:

*Percentages do not add to 100 due to rounding.

APPENDIX C

STATISTICAL TESTS

The reason for subjecting the data generated by this study to statistical analyses was to determine if the differences found, between the samples, could be accounted for by chance fluctuations (Tuckman, in print). Furthermore, the choice of a particular test was determined in light of the following recommendations:

> . . . a combination of interval measures as independent and dependent variables requires the use of correlation techniques (parametric correlations). Tests such as t-tests and analysis of variance requires that the independent variable(s) be nominal and the dependent variable interval. Original measurement generally requires the use of nonparametric techniques, while a combination of a nominal independent and nominal dependent variable requires chi-square analysis. [Tuckman, in print]

The Mann-Whitney U-test was employed in lieu of the one-way analysis of variance when the sample variances were found to be unequal.

The specific computer programs used for the various statistical tests are as follows:

Analysis of Variance: Analysis of variance for one-way design BMDOIV

Pearson Product-Moment Correlation: Class D--Description and Tabulation, BMDO3D Correlation with item deletion

Chi-Square: Class S--Special Program S, BMDO2S Contingency Table

Mann-Whitney U-Test: Program--FORTGCS UTEST